Argentinosaurus leg

Αρ. 139 Α – ΙΟΥΝΙΟΣ 2020

ΕΛΛΗΝΙΚΗ
ΕΠΙΣΤΗΜΟΝΙΚΗ
ΕΤΑΙΡΕΙΑ
ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ
& ΓΕΩΤΕΧΝΙΚΗΣ
ΜΗΧΑΝΙΚΗΣ

139
Α

Τα Νέα της Ε Ε Ε Ε Γ Μ

Όρυγμα αυτοκινητοδρόμου στην Αίγυπτο

SIMSG ISSMGE

ISRM

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

ΑΡΘΡΑ

Η Γη ως Γεωβιοσύνολο: Γεωποικιλότητα και Βιοποικιλότητα

Σπύρος Παυλίδης, Ομότιμος Καθηγητής Γεωλογίας ΑΠΘ

Εισαγωγή

Σύμφωνα με την οικολογική αντίληψη όλα τα είδη ζωντανών οργανισμών ενός οικοσυστήματος επηρεάζουν το ένα το άλλο, και φυσικά επηρεάζονται από το στενό περιβάλλον, λίμνη, χώμα, θάλασσα, αέρα. Σ' αυτή την κατάσταση το «ανόργανο» περιβάλλον και τα έμβια όντα δρουν ως ένα αυτόνομο σύστημα. Αυτό το σύστημα επηρεάζει και επηρεάζεται από τα διπλανά του οικοπεριβάλλοντα, δημιουργώντας ένα ευρύτερο οικοσύστημα. Η διαμόρφωση των ιδεών για το **οικοσύστημα**, δηλαδή για την αλληλεπίδραση των διαφόρων ειδών μεταξύ τους, είχε καταλυτική επίδραση τόσο στην επιστήμη της βιολογίας όσο και ευρύτερα. Η οικολογία αποτελεί την πρώτη ενοποιητική αντίληψη στη σύγχρονη επιστήμη, το πεδίο όπου έπρεπε οι ζωικοί οργανισμοί να εξετάζονται ως σύνολο.

Το **οικοσύστημα** από επιστημονικής άποψης βασίζεται σε δύο θεμελιώδεις αρχές, της ενεργειακής ροής στο εσωτερικό του και της ανακύκλωσης θρεπτικών ουσιών. Πυρήνας της οικολογικής σκέψης εξακολουθεί να είναι η παραδοχή ότι τα είδη φυτών και ζώων αλληλοεπηρεάζονται, εξαρτώμενα άμεσα το ένα από το άλλο, αλλά και από το αβιοτικό περιβάλλον τους. Έτσι οδηγηθήκαμε στην πιο ολιστική αντίληψη του *οικοσυστήματος,* είτε του περιορισμένου γεωγραφικά, είτε του μεγαοικοσυστήματος, καθώς και στην έννοια ολόκληρου του **γήινου οικοσυστήματος**. Στο γήινο οικοσύστημα υπεισέρχεται η διαχρονικότητα και η σπουδαιότητα του «ανόργανου» περιβάλλοντος.

Τα συμπεράσματα που ίσχυαν για μεμονωμένα είδη και άτομα έπρεπε να επανεξεταστούν και να επαναπροσδιοριστούν στο πλαίσιο αλληλεπιδράσεων μεταξύ διαφορετικών ειδών και του φυσικού περιβάλλοντος, της βιόσφαιρας, συμπεριλαμβανομένου του εδάφους και των πετρωμάτων του φλοιού. Το γεγονός ότι υπάρχει ισχυρή αλληλεπίδραση μεταξύ των ειδών σημαίνει ότι η λειτουργία τους δεν μπορεί να κατανοηθεί μεμονωμένα.

Ο κόσμος των ζωντανών οργανισμών χαρακτηρίζεται από τη μεγάλη και θαυμαστή **ποικιλομορφία** (βιολογική ποικιλότητα) και **πολυπλοκότητα**, που είναι συνέπεια της επίδρασης του περιβάλλοντος (ποικιλότητα περιβαλλόντων ή γεωποικιλότητα). Επίσης, συνειδητοποιήθηκε σταδιακά ότι και ο εγωκεντρικός άνθρωπος, «κέντρο του σύμπαντος» και ξεχωριστό αυτοδύναμο δημιούργημα ως κυρίαρχη άποψη, αποτελεί αναπόσπαστο τμήμα του βιόκοσμου και υπόκειται στις ίδιες αλληλεπιδράσεις. Γι' αυτό η **οικολογία**, αν και κλάδος της επιστήμης της βιολογίας, επεκτάθηκε εντυπωσιακά με μεγάλες πολιτικές διαστάσεις και πολλές φορές υπερκάλυψε άλλες επικρατούσες κοινωνιολογικές και οικονομικές θεωρίες. Η οικολογία έγινε και εξακολουθεί να είναι κοινωνικό και πολιτικό κίνημα, με τις θετικές και τις αρνητικές του πλευρές, που αντιπροσωπεύει μια άλλη αντίληψη για το βιόκοσμο, με την ουσιαστική συμμετοχή και του ίδιου του ανθρώπου. Η σύγχρονη οικολογία εξακολουθεί να έχει επίκεντρο τον άνθρωπο, εξετάζει τις ανθρωπογενείς περιβαλλοντικές αλλαγές και τονίζει τις συνέπειες τους για τον άνθρωπο. Η οικολογία είναι **ανθρώπινη οικολογία**. Αντίθετα, η άποψη που θεωρεί τη Γη ένα συνεκτικό δομικό και λειτουργικό σύνολο μέσα στο πλαίσιο της γεωλογικής εξέλιξης είναι διαφορετική. Βλέπει όχι μόνο σημαντικές αλληλεπιδράσεις, αλλά μια άρρηκτη συνέχεια, ένα **βιογεωσύνολο**. Δίνει ιδιαίτερη προσοχή στις «ανόργανες»-γεωλογικές διεργασίες του πλανήτη, στις σχέσεις τους με τη ζωή και μάλιστα με αυτό που η παραδοσιακή εκπαίδευση μας κατατάσσει ως «κατώτερη ζωή», η σημασία της οποίας είναι πολύ μεγαλύτερη στις βιο-γεωλογικές λειτουργίες.

Οι έννοιες της βιοποικιλότητας και γεωποικιλότητας

Βιοποικιλότητα (biodiversity), ή βιολογική ποικιλότητα, ονομάζεται το σύνολο των βιολογικών ειδών που υπάρχουν σήμερα στον πλανήτη μας και τα οικοσυστήματα που συγκροτούν. Η βιοποικιλότητα, επεκτείνεται, με τη μελέτη των απολιθωμάτων, και σε παλιότερες γεωλογικές εποχές, στα είδη που έχουν εξαφανιστεί και στα παλαιοπεριβάλλοντα τους. Ο μεγάλος αριθμός και η ποικιλομορφία των μορφών ζωής στη Γη είναι το αποτέλεσμα εκατοντάδων εκατομμυρίων χρόνων εξελικτικής ιστορίας.

Σύμφωνα με την Ελληνική Νομοθεσία: «*Βιολογική ποικιλότητα ή βιοποικιλότητα είναι η ποικιλία των ζώντων οργανισμών πάσης προελεύσεως, περιλαμβανομένων, μεταξύ άλλων, των χερσαίων, θαλασσίων και άλλων υδατικών οικοσυστημάτων και οικολογικών συμπλεγμάτων, των οποίων αποτελούν μέρος. Επίσης, περιλαμβάνεται η ποικιλότητα εντός των ειδών, μεταξύ ειδών και οικοσυστημάτων (άρθρο 2 του ν. 2204/1994, ΦΕΚ 59 Α΄). Στη βιολογική ποικιλότητα περιλαμβάνεται, τέλος, η ποικιλότητα των γονιδίων μέσα και μεταξύ των ειδών.*

Γεωποικιλότητα (geodiversity): Από τα μέσα της δεκαετίας του 1990 άρχισε να χρησιμοποιείται ο όρος «γεωποικιλότητα» για να περιγράψει την ποικιλία των δομών, γεωμορφών και των διαφόρων γεωλογικών περιβαλλόντων της επιφάνειας της Γης. Ορίζεται ως το «*φυσικό εύρος (ποικιλία) των γεωλογικών (πετρώματα, ορυκτά, απολιθώματα), γεωμορφολογικών (τοπία και φυσικές διεργασίες) και εδαφικών μορφών*».

Επίσης ο όρος γεωποικιλότητα χρησιμοποιήθηκε για να περιγράψει την ποικιλία των μορφών και συστημάτων της γης (the diversity of earth features and systems), τόσο στη σημερινή δομή και επιφανειακή μορφολογία του γήινου φλοιού, όσο και διαχρονικά, δηλαδή στη διάρκεια της αλλαγής των γεωπεριβαλλόντων.

Η γεωποικιλότητα περιλαμβάνει τεκμήρια για την ιστορία της Γης (βιοδηλωτικά ίχνη, παλαιο-οικοσυστήματα) και μια ποικιλία διεργασιών (γεωλογικών, βιογεωλογικών, υδρολογικών και ατμοσφαιρικών) που ενεργούν στα πετρώματα, στη γήινη μορφολογία και τα εδάφη, που παρέχουν το πλαίσιο για τη ζωή στη Γη. Η γεωποικιλότητα αποτελεί το συνδετικό κρίκο μέσω της αλληλεπίδρασης με τη βιοποικιλότητα, τα εδάφη, τα ορυκτά, τις διεργασίες διάβρωσης, απόθεσης ιζημάτων και το δομημένο ανθρωπογενές περιβάλλον, γιατί η ανθρώπινη δραστηριότητα και πρόοδος συνδέονται πάντα στενά με το γεωπεριβάλλον.

Προϋπόθεση της βιοποικιλότητας είναι η γεωποικιλότητα. Τα διάφορα γεωλογικά-κλιματικά περιβάλλοντα του πλανήτη μας, καθώς και εκείνα της διαχρονικής γεωλογικής εξέλιξης του, που διαμορφωθήκαν και μεταβλήθηκαν κατά τη διάρκεια των γεωλογικών χρόνων, επηρέασαν, διαμορφώσαν τα ζωικά είδη, οδήγησαν στον αφανισμό πολλά από αυτά, ενώ έδωσαν χώρο για την ανάπτυξη άλλων ειδών.

Από το οικοσύστημα στη ζωντανή γη

Είναι η Γη απλώς ένας «ανόργανος» πλανήτης με ζωή πάνω του; Ποια είναι η αμφίδρομη σχέση «ανόργανης» και «οργανικής» ύλης; Γης και Ζωής;

Σε πρώτη προσέγγιση και σύμφωνα με την επικρατούσα επιστημονική αντίληψη, η Γη θεωρείται ένας ανόργανος πλανή-

της πάνω στον οποίο αναπτύσσεται ζωή. Οι περισσότεροι επιστήμονες ακόμη και σήμερα, καθώς και η συντριπτική πλειοψηφία των σύγχρονων ανθρώπων, εξακολουθούν να θεωρούν το φυσικό κόσμο, εκτός από τα έμβια όντα, νεκρή και ξένη ύλη, που έχει μικρή ή καθόλου σχέση με εμάς τους ανθρώπους και γενικά με τους βιολογικούς οργανισμούς, ή απλώς αποτελεί τον ουδέτερο χώρο πάνω στον οποίο ριζώνουμε και κατοικούμε. Τον αποκαλούν ανόργανο κόσμο, που λειτουργεί μηχανιστικά και βρίσκεται σε μια μαθηματική κανονικότητα, που έχει τους δικούς του ουδέτερους νόμους. Αυτή είναι η **μηχανιστική φιλοσοφία** στις φυσικές επιστήμες και ως προέκταση της αναπτύχθηκε η ιδεολογία της χωρίς όρια τεχνολογικής και οικονομικής ανάπτυξης και απεριόριστης εκμετάλλευσης της φύσης. Το μηχανιστικό αυτό πρότυπο είναι και **ανθρωποκεντρικό**, θεωρεί δηλαδή κυρίαρχο και εξουσιαστή της φύσης τον άνθρωπο. Αποτελεί την κυρίαρχη κοσμοαντίληψη σήμερα. Είναι αλήθεια ότι αυτή η γενική ιδεολογία συνετέλεσε σ' αυτό που αποκαλούμε πρόοδο. Ήδη όμως άρχισε να διαφαίνεται, στον 21ου αιώνα, η άποψη ότι η ίδια η Γη είναι ένας ζωντανός πλανήτης στο σύνολο του, όπως τονίζουν σε πολλά άρθρα και βιβλία τους ο Lovelock, η Margulis, η Σαχτούρη, ο Στουρνάρας και αρκετοί άλλοι, όπου ενοποιούνται οι «ανόργανες» και «οργανικές» μορφές και διεργασίες σ' *ένα ενιαίο αδιαίρετο εξελισσόμενο σύνολο.* **Εξελικτική διαδικασία** μπορεί να θεωρηθεί ως μία αλληλουχία αυθόρμητων φαινομένων, τα οποία προκύπτουν από διαδοχικές αλλαγές και μεταβολές. Η έννοια προέκυψε από τη βιολογική **εξέλιξη**, η οποία είναι ένα επιστημονικό μεθοδολογικό μοντέλο ή παράδειγμα κατά τον φιλόσοφο της επιστήμης Τ. Κούν (Tomas Kuhn), που ερμηνεύει την εμφάνιση όλων των βιολογικών μορφών στο γήινο οικοσύστημα μέσω των αρχών της γενετικής διαφοροποίησης και της περιβαλλοντικής επίδρασης δια της φυσικής επιλογής.

Στη δεκαετία του '60, κατά τη διάρκεια της σχεδίασης των πειραμάτων της NASA για την αναζήτηση εξωγήινης ζωής, ο θεμελιωτής της Θεωρίας της Γαίας Lovelock διατύπωσε την άποψη ότι τα πειράματα δεν πρέπει να σχεδιάζονται έτσι ώστε να αναζητούνται μεμονωμένοι οργανισμοί ή υπολειμματικές οργανικές ουσίες στα εδάφη άλλων πλανητών, αλλά πρέπει να αναζητηθούν πλανήτες οι οποίοι στο σύνολο τους έχουν τα κύρια δομικά, φυσικοχημικά χαρακτηριστικά και τις κατάλληλες συνθήκες ανάπτυξης της ζωής, όπως η Γη. Στα 1990 ο διάσημος αστροβιολόγος Καρλ Σέιγκαν (Carl Sagan) χρησιμοποίησε τα όργανα της διαστημοσυσκευής «Γαλιλαίος», που έφευγε σε ταξίδι προς το Δία με σκοπό την ανίχνευση εξωγήινης ζωής, για να διερευνήσει πιλοτικά τι θα κατέγραφαν ως μοναδικά χαρακτηριστικά του πλανήτη Γη, που σίγουρα «κουβαλάει» ζωή. Η απάντηση ήταν απλή και αναμενόμενη: πολύ νερό (H_20), όζον (0_3), διοξείδιο του άνθρακα ($C0_2$), ελάχιστο μεθάνιο (CH_4) και χλωροφύλλη. Το όζον της ανώτερης τροπόσφαιρας είναι ενδεικτικό των μεγάλων ποσοτήτων οξυγόνου της ατμόσφαιρας. Αποτελεί επίσης ένδειξη ύπαρξης ζωής. Ανιχνεύτηκε και το νερό, το βασικό στοιχείο της ζωής. Το διοξείδιο του άνθρακα, το οποίο και αυτό με τη σειρά του είναι ένωση πιθανής ζωικής προέλευσης, καθώς και η χλωροφύλλη, δηλαδή η ύπαρξη φυτών, αποτελούν έμμεσες ενδείξεις της ύπαρξης ζωής. Τον άνθρωπο και τα μεγάλα ζώα δεν τα ανίχνευσε. Το λίγο μεθάνιο όμως, αέριο που αντιδρά με το οξυγόνο και είναι αδύνατο να υπάρξει στην ατμόσφαιρα για μεγάλο χρονικό διάστημα, προβλημάτισε τους επιστήμονες. Οι ανιχνεύσιμες ποσότητες θεωρήθηκε ότι ήταν αδύνατον να έχουν δημιουργηθεί από γεωλογικές διαδικασίες. Το μεθάνιο αυτό, όπως αποδείχτηκε, ήταν κυρίως προϊόν αερίων της πέψης της κυτταρίνης στα στομάχια των μηρυκαστικών ζώων. Οι αγελάδες ανιχνεύθηκαν από το «Γαλιλαίο» έμμεσα, από τα εντερικά τους αέρια!

Το **περιβάλλον** είναι και αυτό **πολυπαραγοντικό** με κύριες παραμέτρους το γεωγραφικό πλάτος του, το υψόμετρο του, τον ενδοηπειρωτικό ή παραθαλάσσιο χαρακτήρα του, τις τοπικές κλιματικές του συνθήκες, επεκτείνεται όμως ακόμη περισσότερο, σε όλα τα γεωσυστήματα, από τον πυρήνα της Γης μέχρι την ανώτατη ατμόσφαιρα. Το κλίμα επηρεάζει τη ζωή. Η ζωή από την πλευρά της επηρεάζει την ατμόσφαιρα και κατά συνέπεια το κλίμα, όχι μόνο σε μικροκλίμακα, αλλά στο σύνολο του πλανήτη. Αυτή είναι η άλλη μεγάλη επαναστατική αντίληψη, απόσταγμα των απόψεων της θεωρίας της Γαίας του J. Lovelook και των συνεχιστών του, που διατυπώνεται ως εξής « *Η σημαντικότερη ιδιότητα της Γαίας είναι η τάση να διατηρεί σταθερές συνθήκες για όλες τις γήινες μορφές ζωής.* Με *την προϋπόθεση ότι δεν έχουμε προξενήσει σοβαρές βλάβες στην κατάσταση ομοιόστασης της, αυτή η τάση θα πρέπει και σήμερα να είναι τόσο κυρίαρχη όσο και πριν από την εμφάνιση του ανθρώπου στο προσκήνιο».*

Η ζωή φροντίζει για την **ομοιοστασία** της **Γης**, για τη διακύμανση των κλιματικών αλλαγών μέσα σε ορισμένα ανεκτά όρια, ώστε να διατηρείται και να συνεχίζει την πορεία της. Η ομοιοστασία ήταν έννοια αποκλειστικά βιολογική, που χαρακτηρίζει την ικανότητα του οργανισμού να διατηρεί σταθερές τις συνθήκες του εσωτερικού του περιβάλλοντος (θερμοκρασία, συγκεντρώσεις διάφορων συστατικών κτλ.), παρά τις εξωτερικές μεταβολές. Είναι ουσιαστικά μια **προσαρμογή στην αλλαγή.** Όλοι οι ζωντανοί οργανισμοί, είτε μονοκύτταροι είτε πολυκύτταροι, παρουσιάζουν ομοιοστασία. Σήμερα όμως η έννοια της ομοιοστασίας χρησιμοποιείται και στη γεωλογία για να προσδιορίσει τη σταθερή διακύμανση της θερμοκρασίας του γήινου συστήματος σε όρια που να επιτρέπουν τη διατήρηση της ζωής. «*Ομοιοστασία, σύμφωνα με άλλο πιο εξειδικευμένο ορισμό, είναι η ιδιότητα ενός ανοιχτού συστήματος να ρυθμίζει το εσωτερικό του περιβάλλον ώστε αυτό να διατηρείται σε μια σταθερή κατάσταση, μέσω πολλαπλών προσαρμογών δυναμικής ισορροπίας, που ελέγχονται από ενδοσυνδεόμενους μηχανισμούς ρύθμισης*». Η Γη είναι τέτοιο ανοιχτό σύστημα.

Η αρχική ιδέα να θεωρείται η Γη ζωντανός οργανισμός, όπως προαναφέρθηκε, βρίσκεται στους μύθους, στην αρχαιοελληνική σκέψη και κατά την επιστημονική εποχή έχει τις ρίζες της στο γιατρό-γεωλόγο Nikolaus Steno, στον επίσης γιατρό, φυσιοδίφη και πρωτοπόρο γεωλόγο Σκωτσέζο James Hutton (τέλη 18ου αρχές 19ου αιώνα) και σε ορισμένους άλλους διανοητές της εποχής, ιδιαίτερα στο θεμελιωτή της γεωχημείας, φιλόσοφο Ρώσο γεωεπιστήμονα, καθηγητή της ορυκτολογίας Vladimir Vernadsky, στις αρχές του 20ου αιώνα. Ο Vernadsky επεξέτεινε ουσιαστικά την έννοια της **βιόσφαιρας** σε δυναμικό σύστημα με τη συμμετοχή της ζωής ως γεωλογικού παράγοντα και την όριζε ως: «*Βιόσφαιρα είναι η μοναδική, μέγιστη γεωλογική δύναμη στη Γη, η οποία κινείται, επεξεργάζεται και ανακυκλώνει δισεκατομμύρια τόνους μάζας κάθε χρόνο*». Είναι το πολυπλοκότερο υποσύστημα ενός κεντρικού κυβερνητικού συστήματος, του γήινου, το οποίο τείνει προς μία δυναμική ανισορροπία και προς μία τρομακτική εσωτερική ανομοιότητα. Ενώ η θεωρία της Γαίας, ως συνέχεια των προηγουμένων απόψεων, δεν είναι τίποτα παραπάνω από το συνδυασμό των επιστημονικών εκείνων γνώσεων που μιλούν για την ισορροπία Γης-Ζωής και ερμηνεύουν τον πλανήτη μας ως ένα «*ζωντανό μεγαλοοργανισμό*».

Η Γη ως ένα ενιαίο μεγασύστημα

Είναι η Γη σύστημα;

Η Γη αποτελείται από πολλά μέρη και παρουσιάζει πολύ μεγάλη ποικιλομορφία (γεωπεριβάλλοντα, γεωποικοιλότητα διαχρονικά μεταβαλλόμενη). Σαφέστατα πληροί τα κριτήρια για να ονομαστεί Σύστημα, γιατί είναι ένα υπερσύνολο επιμέρους τμημάτων (γεώσφαιρες), τα οποία αλληλοεπιδρούν και αλληλοεπηρεάζονται.

Γιατί το Γήινο Σύστημα είναι Πολύπλοκο ;

Για να χαρακτηριστεί ως πολύπλοκο ένα λειτουργικό σύστημα ύλης και ενέργειας, όπως είναι και το γήινο, πρέπει να πληροί

ορισμένες προϋποθέσεις. Ήδη άρχισε να διαφαίνεται η σύνθεση αυτού του πλανήτη που αποτελείται από **επιμέρους ενότητες** (μέρη) ή **γεώσφαιρες** ή **υποσυστήματα** που δεν λειτουργούν ανεξάρτητα, έστω και αν διαχωρίζονται για να μελετώνται και να κατανοούνται καλύτερα, αλλά **αλληλοεπηρεάζονται** και **αλληλεξαρτώνται** ώστε να συγκροτούν ένα ενιαίο σύνολο. Είναι δηλαδή μια σύνθετη-πολύπλοκη δομή. Αρά χαρακτηρίζεται **Πολύπλοκο Σύστημα** αποτελούμενη από πολλαπλά αλληλοεπιδρώντα μέρη.

Πέρα από τη **μηχανιστική αντίληψη** για τη μελέτη και ερμηνεία των φυσικών συστημάτων, με ένα τρόπο που λέγεται **αναγωγικός** ή **αναλυτικός** (αναγκαιότητα της μηχανιστικής λειτουργίας) σήμερα εξετάζονται στο πλαίσιο των εννοιών, όπως: «***Αυτοοργάνωση*** *είναι μια λειτουργία ή ένας μηχανισμός, ο οποίος υπό κατάλληλες συνθήκες ενεργεί αυθόρμητα με βάση τους φυσικούς νόμους. Δημιουργεί αυτορρυθμιζόμενα συστήματα, τα οποία εισάγουν στο εσωτερικό τους ενέργεια, τη μετασχηματίζουν και εξάγουν στο περιβάλλον τους εντροπία, συνήθως υπό μορφή θερμότητας, διατηρώντας ή ενισχύοντας μία περίπλοκη εσωτερική δομή. Η μετάβαση ενός συστήματος από ένα στάδιο χαμηλής δομικής πολυπλοκότητας σε ένα στάδιο υψηλότερης πολυπλοκότητας, γίνεται μέσω μίας διαδικασίας που ονομάζεται αυτοοργάνωση. Είναι δυνατόν ένα* αυτόοργανωμένο σύστημα *να είναι συνθετικό, κατασκευασμένο τόσο από τον Άνθρωπο, όσο και φυσικό*».

«***Αυτοποιητικό σύστημα*** *είναι ένα αυτοοργανωμένο σύστημα ιεραρχικά δομημένο, τα επιμέρους τμήματα του οποίου δημιουργούνται (αυτοδημιουργία) και καταστρέφονται (αυτοκατάλυση) σε ένα συνεχή κύκλο. Η έννοια της αυτοποίησης προέκυψε ως εφαρμογή της θεωρίας συστημάτων στη βιολογία με στόχο τον ορισμό της ζωής*».

Στη φύση συνυπάρχουν καταστάσεις τάξης και αταξίας, σχετικά απλά γραμμικά συστήματα που είναι σχετικά εύκολο να ερμηνευτεί η λειτουργία τους και να προβλεφθεί η συμπεριφοράς τους, και απρόβλεπτα πολύπλοκα μη γραμμικά. Οι μεταβλητές που εκφράζουν την συμπεριφορά των πολύπλοκων μη γραμμικών συστημάτων χαρακτηρίζονται από μη κανονικότητα στην εξέλιξη τους, ιδιαίτερα για μακροχρόνια συμπεριφορά είναι **απρόβλεπτη** και **μη επαναλαμβανόμενη**. Ο χρόνος στην εξέλιξη αυτών των συστημάτων έχει **διανυσματική** υπόσταση με **μια φορά κατεύθυνσης**, από το παρελθόν στο μέλλον. Είναι δηλαδή τα φαινόμενα που συμβαίνουν στα συστήματα αυτά **μοναδικά** και **μη επαναλαμβανόμενα**.

Υπάρχει κάποιο αίτιο ή ιδιότητα σύνδεσης των μερών του ?

Όλα τα μέρη (υποσυστήματα) της Γης, από τον εσώτατο πυρήνα, μέχρι την ανώτατη ατμόσφαιρα, αποτελούν μια συνέχεια, δεν μπορούν να υπάρξουν και να λειτουργήσουν ανεξάρτητα, συνδέονται άμεσα και αλληλοεπιδρούν. Τα υποσυστήματα της Γης λειτουργούν αυτόνομα αλλά ταυτόχρονα αλληλοεπιδρούν μεταξύ τους δίνοντας ως αποτέλεσμα το αρχικό, υψηλότερης δομικής περιπλοκότητας σύστημα, του οποίου η συμπεριφορά είναι διαφορετική από οποιονδήποτε απλό **γραμμικό συνδυασμό** συμπεριφορών των μερών του (μη γραμμικό σύστημα). Η Γη ως πολύπλοκο σύστημα χαρακτηρίζεται από ισχυρή εξάρτηση και **ποικιλομορφία** μεταξύ των μερών τους.

Το γήινο σύστημα έχει οργάνωση ?

Από όσο έχουν περιγράφει προηγουμένως για το γήινο μεγασύστημα φαίνεται ότι έχει οργάνωση και μάλιστα πολύ καλά δομημένη και ιδιαίτερα πολύπλοκη. Είναι ένα σύστημα με πολλά **υποσυστήματα**, δηλαδή χαμηλότερης πολυπλοκότητας συστήματα.

Έχει μη προβλέψιμη συμπεριφορά ? Είναι μη γραμμικό σύστημα ?

Σύμφωνα με τη **Θεωρία του Χάους** μικρές διαφορές στις αρχικές συνθήκες αποδίδουν πολύ διαφορετικά αποτελέσματα για τα δυναμικά συστήματα, καθιστώντας τη μακροπρόθεσμη πρόβλεψη αδύνατη σε γενικές γραμμές. Οι κλιματικές αλλαγές, μεταβολές και διακυμάνσεις, παρόλο που επαναλαμβάνονται, δεν είναι με σαφήνεια προβλέψιμες. Η πρόγνωση των σεισμών σήμερα θεωρείται αδύνατη, λόγω της πολυπλοκότητας του φαινομένου και των πολλών παραγόντων που το επηρεάζου.

Είναι αυτό-οργανωμένο σύστημα ?

Το γήινο μεγασύστημα παρουσιάζει καινοφανείς συλλογικές συμπεριφορές οι οποίες δεν μπορούν να αναχθούν στα μεμονωμένα μέρη του συστήματος αλλά οφείλονται στις αλληλεπιδράσεις και τις συσχετίσεις τους.

Σύμφωνα με τους ορισμούς των πολύπλοκων συστημάτων και τις αλληλοεπιδράσεις, που σαφώς διακρίνονται και στο γήινο μεγασύστημα, και πάντα σε συνδυασμό με τις θεμελιώδεις αρχές της γεωλογίας, τείνουν να διαμορφώσουν την αντίληψη ότι η Γη είναι ένα **αυτοποιητικό σύστημα**, δηλαδή **ένας *γήινος* αυτορυθμιζόμενος-αυτοεξελισσόμενος οργανισμός** (self-organized criticality). Οι αντιλήψεις αυτές και η αντίστοιχη έρευνα, βρίσκονται σήμερα στο αρχικό τους στάδιο, σε εμβρυακή μορφή, θα ωριμάζουν όμως με την πορεία και τις δοκιμασίες του χρόνου στις γεωεπιστήμες και τις συναφείς επιστήμες αλλά παράλληλα και στην κοινωνία. Τα μηχανικά μας μοντέλα, που ερμηνεύουν κλειστά συστήματα, τα οποία βρίσκονται σε τέλεια τάξη, υπακούν σε συγκεκριμένους νόμους και άρα είναι προβλέψιμα. Ακριβώς το αντίθετο συμβαίνει στα γήινα συστήματα. Η λειτουργία και συμπεριφορά όλων των συστημάτων της Γης είναι μη προβλέψιμη, υπόκειται στους νομούς της τυχαιότητας και του χάους. Το σημαντικό πρόβλημα της πρόγνωσης των σεισμών, για παράδειγμα, δεν μπορεί να βρει τη λύση του μόνο με τα μηχανικά μας μοντέλα και οδηγείται σε αδιέξοδο. Είναι πολύπαραγοντικό και ιδιαίτερα πολύπλοκο. Ο ρόλος των ρευστών για παράδειγμα δεν λαμβάνεται υπόψη στη μελέτη των διεργασιών της σεισμογένεσης και της ρηγματογένεσης. Το νερό, στοιχείο της ζωής, φαίνεται ότι είναι πολύ σημαντικός παράγοντας στις διεργασίες του «ανόργανου» γήινου φλοιού. Η ανταλλαγή αερίων μεταξύ ατμόσφαιρας, γήινου φλοιού και μανδύα βρίσκεται στο αρχικό στάδιο μελέτης. Η Γη με τη συνεχή ανταλλαγή αερίων με την ατμόσφαιρα φαίνεται να «αναπνέει».

Τι εννοούμε όμως με τον όρο ***αυτορρυθμιζόμενο*** *ή* ***αυτοοργανωμένο σύστημα***; Ο επιστημονικός προβληματισμός στα τέλη του 20ου αιώνα μετά τη μελέτη της θερμοδυναμικής και των συστημάτων που βρίσκονται σε κατάσταση ισορροπίας ή κοντά σ' αυτήν, τη μελέτη δυναμικών συστημάτων σε κατάσταση μη ισορροπίας, την έννοια της οικολογίας, την εντυπωσιακή συσσώρευση βιολογικών γνώσεων, την πολυπλοκότητα των ατμοσφαιρικών φαινομένων με τη δυσκολία της πρόγνωσης του καιρού και τη **θεωρία του χάους**, έκανε τους επιστήμονες να αρχίσουν να βλέπουν τον κόσμο και τα φαινόμενα του σαν είδωλα σε έναν «ταραγμένο καθρέφτη» (τίτλος βιβλίου για τη θεωρία του χάους). Αυτοοργανωμένο και αυτορρυθμιζόμενο σύστημα θεωρείται εκείνο που είναι αυτόνομο, δηλαδή αυτοσυντηρείται και αυτοαναπαράγεται.

«***Χάος*** *στην καθομιλουμένη, εννοούμε την παντελή έλλειψη τάξης. Χάος για τα μαθηματικά σημαίνει όταν το παρόν καθορίζει το μέλλον, αλλά η προσέγγιση του παρόντος δεν προσδιορίζει με ακρίβεια το μέλλον. Η* ***θεωρία του Χάους*** *μελετά τη συμπεριφορά ορισμένων μη γραμμικών δυναμικών συστημάτων, που είναι ιδιαίτερα ευαίσθητα στις αρχικές συνθήκες*». Χαοτική συμπεριφορά μπορεί να παρατηρηθεί σε πολλά φυσικά συστήματα, όπως είναι η ***ατμόσφαιρα***, ένα **οικοσύστημα**, η **λιθόσφαιρα** και οι κινήσεις των τεκτονικών πλακών, οι **σεισμοί**, τα **οικονομικά συστήματα** και η **εξέλιξη των έμβιων όντων**. Αποτελεί τομέα των μαθηματικών, με

διάφορες εφαρμογές σε κλάδους επιστημών όπως η φυσική, η μηχανολογία, η οικονομία και η βιολογία.

Στη μετεωρολογία ειπώθηκε ότι μια μικρή και «ασήμαντη» μεταβολή, όπως το πέταγμα της πεταλούδας, μπορεί να προκαλέσει μια μεγάλη αλλαγή του καιρού στο άλλο άκρο του πλανήτη, μόνο όταν εκεί φυσικά επικρατούν ώριμες συνθήκες αλλαγής, βρίσκεται δηλαδή σε **κρίσιμο σημείο** (critical point). Στη σεισμολογία τονίστηκε ότι η πτώση ενός «κόκκου άμμου», ένα νανοράγισμα μπορεί να ενεργοποιήσει ένα ώριμο ρήγμα και να προκαλέσει σεισμό. Η «κατάρρευση» ενός μικρού ρήγματος μπορεί με τη σειρά της να υποδαυλίσει ένα άλλο μεγαλύτερο ρήγμα και να δώσει έναν ακόμη πιο ισχυρό σεισμό, σαν ντόμινο.

Η βιολογία μάς λέει ότι η **ζωή** δεν είναι ενδογενής ιδιότητα της οργανικής ύλης, αλλά **ιδιότητα της οργάνωσης της ύλης**. Ένα αξίωμα που ανατρέπει ριζικά τη σκέψη μας για τη ζωή, για την οργάνωση και τη λειτουργία των κυττάρων και των οργανισμών. Αν με τον όρο ζωή εννοούμε την «οργανική ύλη», αλλά κυρίως την οργανωμένη ύλη, τότε θαυμάσια **οργανωμένος είναι και ο πλανήτης μας στο σύνολο** του. Η Γη έχει τη δική της οργάνωση, σημαντικά διαφορετική από εκείνη ενός έμβιου όντος, έχει μια πολύπλοκη και θαυμαστή δομή και λειτουργία. Στην πολυπλοκότητα της βρίσκεται η ιδέα της αυτορρύθμισης, ή καλύτερα της αυτοοργάνωσης των συστημάτων, κάτω από ορισμένες συνθήκες. Οι νόμοι της φυσικής είναι τόσο απλοί που δεν μπορούν να περιγράψουν την πολυπλοκότητα της φύσης.

Την επικρατούσα μέχρι και σήμερα αντίληψη, ότι η Γη είναι ένας πλανήτης που συγκροτείται από ανόργανα υλικά και έχει το προνόμιο να φιλοξενεί ζωή πάνω του, έρχονται να την ανατρέψουν πλήθος νέα στοιχεία της βιολογίας και γεωλογίας, καθώς και νέοι προβληματισμοί. Η ζωή δεν είναι ξένη ή ανεξάρτητη που έτυχε απλώς να κατοικεί στον πλανήτη μας. Έναν οίκο χτισμένο όπως το σπίτι μας από νεκρά υλικά, πέτρες, ξύλα, τσιμέντο, γυαλί και μέταλλα. Οι ανόργανες και οι οργανικές μορφές του έχουν **ασαφή όρια** και παρουσιάζουν μια **συνέχεια.** Ήδη άρχισε να διαφαίνεται η άποψη ότι η ίδια η Γη είναι ένας «**ζωντανός πλανήτης**»**.**

Τα πάντα μεταβάλλονται, αλλάζουν και εξελίσσονται στη Γη και τα έμβια όντα. Τα συστήματα της Γης και της Ζωής βρίσκονται σε μια συνεχή ανταλλαγή των ίδιων υλικών και σε μια διαρκή λειτουργική αλληλοεπίδραση, τόσο στενή, ώστε να συμπεριφέρονται ως **ενιαίο σύνολο**. Μια καινούρια δηλαδή θεώρηση της λειτουργίας της Γης και της ζωής που πηγάζει απ' αυτήν και η οποία εκδηλώνεται για δισεκατομμύρια χρόνια πάνω στο λεπτότατο και ευκίνητο φλοιό, στη λεγόμενη **βιόσφαιρα***,* τα όρια της οποίας είναι ιδιαίτερα ασαφή και περιορισμένα. Η ύλη από την οποία συγκροτείται η διαρκώς ανανεώσιμη *βιόσφαιρα* έχει ανακυκλωθεί πάρα πολλές φορές, τόσο στην επιφάνεια όσο και στο εσωτερικό της Γης, ώστε να υπάρχει μια διαρκής αμφίδρομη σχέση «ανόργανης» και «οργανικής» ύλης. Γεωλογικές και βιολογικές διεργασίες ενοποιούνται σ' ένα ενιαίο σύνολο, όπου υπερσύνολο είναι η Γαία-Γη και ένα μόνο υποσύνολο της είναι η ζωή. Η ζωή πηγάζει από τη Γη και επιβιώνει ως αναπόσπαστη εκδήλωση της.

Επίλογος

Το άρθρο αυτό προσπαθεί να επισημάνει και να συμπυκνώσει μερικές σημαντικές απόψεις, που συνέβαλαν σημαντικά στην εξέλιξη της ανθρώπινης σκέψης και βοηθούν να κατανοηθεί καλύτερα το περιβάλλον και οι μεγάλες διαχρονικές μεταβολές του. Δίνει με απλό τρόπο έμφαση στη **βιογεωλογική** ενότητα του κόσμου μας και την **πολυπλοκότητά** του, διατρέχοντας την **εξέλιξη των ιδεών** για τη Γη και τις διεργασίες της, από τους προσωκρατικούς φιλοσόφους μέχρι τη σημερινή αντίληψη της Γαίας. Εξετάζονται με φιλοσοφική διάθεση, η διάσταση του γεωλογικού χρόνου, η αέναη κινητικότητα του φλοιού της Γης και η διαρκής δημιουργία διαφορετικών γεωπεριβαλλόντων, μιας καταπληκτικής **γεωποικιλότητας**. Δίνεται έμφαση στην παράλληλη εξέλιξή της Ζωής, ο ρόλος και η πορεία του ανθρώπου μέσα σ' αυτόν τον κύκλο, και η εντυπωσιακά μεγάλη **βιοποικιλότητα**. Επίσης τονίζεται η αδιάρρηκτη σχέση ζωντανής και ανόργανης ύλης στην οικολογική της προσέγγιση, η ανάπτυξη της ζωής και η συμβίωσή της.

Η ονομασία γαία, αρχαιοελληνικής μυθολογικής προέλευσης, που προτάθηκε και καθιερώθηκε ως επιστημονικός ορός από τους James Lovelock, Lynn Margulis (δεκαετία 1970-80), και άλλους αργότερα, και στα ελληνικά από την Ελισάβετ Σαχτούρη ("Γαία", 1989), Σπ. Παυλίδη (ΠΑΝ-ΓΑΙΑ, 2007) και Γ. Στουρνάρα (Παμμήτειρα Γαία, 2016), έχει τις επιστημονικές και φιλοσοφικές ρίζες της στους Pierre Teilhard de Chardin, Vladimir Vernadsky (δεκαετία 1920), και τους θεμελιωτές της Οικολογίας, δεν είναι τυχαία, αφού η Γαία ήταν η μητέρα του παντός, παμμήτειρα Γαία κατά τον ορφικό ύμνο, μεγάλη θεά, η Γη στο σύνολό της, η ίδια η Φύση.

Η Γη, ως αποτέλεσμα των συμπαντικών διαδικασιών και εξελίξεων, έχει τη δική της ιστορία. Η διαμόρφωση της Γης συνεχίζεται αδιαλείπτως μέχρι σήμερα, με μια σειρά διαδικασιών, που επιτρέπουν στον πλανήτη μας να θεωρείται ενιαίος και ως ένα **υπερ- σύνολο,** ή καλύτερα **Σύστημα Συστημάτων**. Η Φύση βρίσκεται σε κατάσταση μη ισορροπίας, και γι' αυτό και παραμένει **δυναμική**. Από πλευράς δομής, και το στερεό μέρος της φύσης είναι επίσης σε κατάσταση μη ισορροπίας και χαρακτηρίζεται από ***ασυνέχεια, ετερογένεια*** και ***ανισοτροπία,*** ιδιότητες που έχουν νόημα μόνο σε συγκεκριμένες κλίμακες θεωρήσεως. *«Οι αντιδράσεις της Γαίας στις αλλαγές προς το χειρότερο, πρέπει να υπακούν στους κανόνες της κυβερνητικής, όπου η σταθερά χρόνου και η απολαβή βρόχου αποτελούν σημαντικούς παράγοντες. Η σταθερά χρόνου στη ρύθμιση του οξυγόνου είναι της τάξης των χιλιάδων ετών. Τόσο αργές διεργασίες, ελάχιστες προειδοποιήσεις παρέχουν για ανεπιθύμητες τάσεις. Μέχρι να καταλάβουμε ότι κάτι δεν πάει καλά και να λάβουμε μέτρα, η αντίσταση της αδράνειας θα φέρει τα πράγματα σε χειρότερη κατάσταση, προτού σταθεί δυνατό να ξεκινήσει μια εξίσου αργή βελτίωση» κατά τον J. Lovelock.*

Τα φυσικά φαινόμενα δεν παύουν να είναι εκφάνσεις μιας **ενιαίας φυσικής πραγματικότητας**. Τα επιμέρους στοιχεία τους συγκροτούν το σύνολο, όχι όμως ως μια απλή άθροιση, γιατί τότε δεν θα αποδίδουν την ολότητα. Οι πολλές μορφές του κόσμου με τις αντιθέσεις τους και τη συνεχή μεταβλητότητα τους εκφράζουν τη βασική **ενότητα όλων**. Η Γη είναι, το πολύπλοκο εκείνο σύστημα με τις αλληλεξαρτήσεις των μερών του, είναι το ***αυτο-οργανωμενο*** και διαρκώς ***εξελισσόμενο μεγασύστημα,*** ένας **αυτορρυθμιζόμενος οργανισμός**, έχει μετατραπεί σε «Γαία», δηλαδή «ζωντανό οργανισμό», και αυτό άρχισε από τα πρώτα στάδια του σχηματισμού της και κορυφώθηκε με την εμφάνιση και εξέλιξη της ζωής, ενώ συνεχίζεται και σήμερα με την τεράστια βιοποικιλότητα και θα συνεχίσει να εξελίσσεται και στο μέλλον. Αυτή είναι η νέα **ολιστική αντίληψη** για τον Οικο-πλανήτη μας, ως **Γεωβιοσύνολο**, που αποτελεί πλέον σε παγκόσμιο επίπεδο μια πρόκληση της επιστήμης. **Πρέπει να κατανοήσουμε τη Φύση και τον Άνθρωπο σε βάθος για να ελπίζουμε σε μια καλύτερη κοινωνία.**

ΒΙΒΒΛΙΟΓΡΑΦΙΑ

Αναγνώστου, Χ., Χρόνης, Γ. (2002). «Το Γήινο Σύστημα. Εισαγωγή στις γεωεπιστήμες». Εκδ.Κ. Χαμηλοθώρης. Αθήνα.

Back, P. (1996). «How Nature Works: The science of self-organized criticality». Springer-Verlag, New York.

Βαλιάκος, Η. (2018). «Αξιολόγηση και Διαχείριση των Γεώτοπων της Ελλάδας**».** Διδ. Διατρ. Παν/μιο Αιγαίου. Μυτιλήνη.

Condie, C, K. (2005). «EARTH as an Evolving Planetary System». Elsevier.

Gaston, Kevin J. and John I. Spicer (επιμέλεια: Χαρίτων Χιντήρογλου, Δημήτρης Βαφείδης). (2008). «Βιοποικιλότητα Μια εισαγωγή» University Studio Press, Θεσσαλονίκη.

Gray, J.M., (2004), Geodiversity: valuing and conserving abiotic nature: Wiley, 434 p.

Encyclopedia of Geology (2005). Edited by R. C. Selley et al. Elsevier Academic Press.

Lenton Tim (2018). «Earth System Science: A Very Short Introduction» Oxford University Press

Lovelock, J. E. (1993). «*ΓΑΙΑ, Μια νέα θεώρηση στη ζωή του πλανήτη* (μετάφραση του GAIA, a new look at life on Earth 1979)». Εκδ. AQUARIUS. Αθήνα.

Lovelock, J. E., «GAIA, Medicine for an ailing planet». Gaia books. 192pp. 3rd Ed. (2005).

Lovelock, J. E. (2007). «*Η εκδίκηση της Γαίας*». Εκδόσεις Α. Α. Λιβάνη. Αθήνα.

Lovelock, J. E. and Margulis, L. (1984). «Gaia and Geognosy», In Global Ecology: Towards a Science of Biosphere. Rambler M.B. (Ed.), 72-79.

Margulis, L. (2002). *«Ο Συμβιωτικός Πλανήτης».* Εκδόσεις Κάτοπτρο. Αθήνα.

Μάρκος, Γ.Α. (2001) «Φύση και άνθρωπος στην αρχαία ελληνική φιλοσοφία». Εκδόσεις Leader Books.

Παυλίδης, Β. Σ. (1999). «*Η Συμβολή της Γεωλογικής Γνώστης στην Εξέλιξη της Ανθρώπινης Σκέψης*». Scientific American, Ελληνική έκδοση, Τόμος Α', Τεύχος 10.

Παυλίδης, Β. Σ. (2007). «ΠΑΝ-ΓΑΙΑ, μια διαφορετική βιο-γεωλογική διαδρομή στον πλανήτη Γη». Εκδόσεις Leader Books. Αθήνα.

Παυλίδης, Σ., Χατζηπέτρος, Α. (2018). Γεωσύστημα «Γαία», κατανοώντας τη δομή και λειτουργία του πλανήτη Γη», Εκδ. Liberal Books. Αθήνα.

Press, F., Siever, R., Grotzinger, J., and Jordan, T.H., (2004), Understanding earth: W.H. Freeman.

Prigogine, I. and Stenges, I. *«Order out of Chaos, Man's New dialogue with Nature»* (1984/2017). Toffler, Al. (Ed.), VERSO

Σαχτούρη, Ε. (1989). «*Γαία (GAIA)».* Εκδόσεις Νέα Σύνορα.

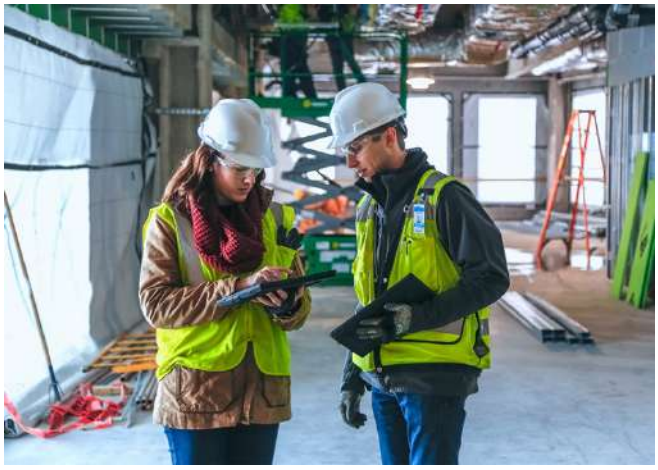
Στουρνάρας Γ. (2017). «*ΠΑΜΜΗΤΕΙΡΑ ΓΑΙΑ,* Ένυδρη έμβια Γαία, μια Διαχρονική Φυσιογνωστική και Φιλοσοφική Προσέγγιση». University Studio Press. Θεσσαλονίκη.

Webb, J. & Alison, G. (Eds), (2018). «This is Planet Earth», New Scientist.

How does civil engineering exploit technology to eliminate error?

Mark Hansford, Director of Engineering Knowledge

Digital engineering, used correctly, is critical to increasing productivity and reducing error. ICE is working with key industry partners to explore the barriers that impede adoption and provide help on the journey towards digital transformation



How can civil engineers best use technology to eliminate costly errors?

Key international studies suggest that the direct cost of avoidable error is in the order of 5% of project value. Research by the industry-led and ICE-backed Get It Right Initiative (GIRI) has revealed that the true figure is closer to 21% or £21bn per annum. It's a big number.

Last year ICE vice-president Ed McCann suggested special registers of civil engineers deemed competent enough to sign off on designs for construction may be needed to arrest the decline in quality of design information being sent to construction sites.

McCann said that action was needed to address an "intergenerational low" in the quality of design information passed to contractors from designers.

"People are talking about an intergenerational low in the quality of design information; they are talking about design drawings that are incomplete, incoherent, uncoordinated and they arrive at site and have to be redrawn and re-engineered," says McCann.

McCann, who led ICE's 2018 review into professional skills and also fronts the Get It Right initiative which is dedicated to eliminating error in the UK construction industry, reflects on a number of causal factors including significant changes to the way the industry operates over 25 to 30 years. Additional causal factors include the abolition of fee scales, the fundamental shift in way work is procured with the shift to design and build as well as the digital revolution in the 1970s when firms started to do computational modelling.

Now, in 2020, there is a new threat: Covid-19. An increase in the number of latent defects, exacerbated by the lack of 'ownership' of errors, could be the most obvious legacy of the Covid-19 pandemic, according to a new snapshot survey of GIRI membership.

GIRI members have highlighted their fears that on operational sites, defects are not currently being recorded, with attention focused almost exclusively on productivity and the need to maintain social distancing requirements.

Digital engineering is clearly central to the debate and, used correctly, is critical to increasing productivity and reducing error. However, very little is known about the barriers that hamper and impede adoption.

What are the barriers to implementing digital engineering technologies?

Last year GIRI commissioned UCL to carry out a literature review into reported evidence of the occurrence of barriers to the adoption of future digital engineering technology. This review took place during the summer of 2019, with the final report issued on 11 September 2019. The review found that, while literature has classified and qualified the barriers to implementing digital engineering technologies, few studies have quantified the impact. As a result, how these technologies have increased productivity and reduced error has remained relatively under-explored.

GIRI has now set up a workstream to review potential solutions so that it can provide the industry with advice and guidance to overcome these barriers – and some of the solutions were explored in the recent ICE Strategy Session Using Technology to Eliminate Error.

Watch the session in full below;

Already seeking to provide much needed support in this area is the UK BIM Alliance. It exists to support organisations in the built environment sector to take the fundamental first steps in their journey to digital transformation.

It is an excellent source of digital expertise and the ICE is pleased to be joining the alliance through its new affiliate programme. The Affiliate programme aims to bring together the professional institutions, trade associations and

any other industry organisations to provide a consistent message and coordinated approach to digital transformation, working across silos to a shared objective.

We hope that through this association the ICE will be more able than ever to keep members up to date with the latest advances in digital technology.

(https://www.ice.org.uk/news-and-insight/the-civil-engineer/june-2020/can-engineers-use-technology-to-eliminate-error)

Earthquakes, Geohazards, and Real-time Remote Monitoring of Onshore and Offshore Gas Pipelines

Dr. Prodromos Psarropoulos
National Technical University of Athens, Greece

Many pipelines have been constructed worldwide, while many others are expected to be constructed in the near future. In parallel, our society demands increasing availability and reliability of energy supply, together with improved environmental standards.

Although most of the pipelines are onshore high-pressure gas pipelines, there is an evident increasing tendency for the construction of offshore gas pipelines. In some areas, such as S.E. Europe and the Mediterranean Sea, the earthquakes and the high seismicity may threaten the integrity of a pipeline since various potential earthquake-related geohazards and the consequent permanent displacements of the ground or the seabed may substantially distress the pipeline. Apart from the strong ground motion, the main potential earthquake-related geohazards are: active-seismic-fault ruptures at the ground surface, soil-liquefaction phenomena, and/or earthquake-triggered landslides.

Seabed morphology of the Mediterranean Sea, where great active-seismic-fault ruptures and submarine landslides frequently take place. (Permission from Atelier Berann, copyright Stern-Magazine)

The simplistic provisions of seismic norms are rather incapable of sufficiently covering all issues of geohazard assessment and seismic design of pipeline projects (especially offshore). Therefore, the optimum (i.e. safe and in parallel cost-effective) design of a pipeline requires, apart from geoscientists familiar with qualitative geohazard assessment, engineers capable to perform the following:

- Quantitative geohazard assessment (based on reliable data);
- Realistic soil-structure interaction analyses; and
- Design of various geotechnical and/or structural mitigation measures (if required).

Nevertheless, in many cases, despite the proper and complete design and construction, there are various reasons for the use of real-time remote monitoring schemes and early-response systems in order to reduce the seismic pipeline risk:

- Human errors and negligence during the design, construction and/or operation phase cannot be excluded. Additionally, norms are not perfect and they are getting improved every 10 to 20 years.
- All input data has a certain degree of uncertainty, and climate change makes this uncertainty even higher (e.g. heavy rainfalls increase the risk of landsliding under static and seismic conditions).
- Seismic design relies on seismological studies based on probabilities and statistical interpretation of data.
- Some pipelines are located in remote isolated areas, with limited accessibility (e.g. mountains) or even zero accessibility (e.g. deep sea).
- As modern seismic design allows certain damage levels (in the case of onshore pipelines), a relatively small aftershock may cause the collapse of a damaged pipeline if the structural damages of the main shock have not been identified and repaired quickly.
- An early-response system (e.g. smart block valves that connect components) may decrease the loss of new or old facilities, and therefore the total risk.

(The International Pipe Line & Offshore Contractors Association NEWSLETTER, Number 83, June 2020, pp. 19-20, https://issuu.com/pms72/docs/iploca_news_83)

Rock-Filled Concrete (RFC) Arch Dam: Innovation leads to growing use of RFC in arch dams

Embankment dams are normally made of local materials. Profs Feng JIN and Xuehui AN at Tsinghua University, China invented a new type of concrete dam, namely rock-filled concrete (RFC) dam, which makes use of local rocks obtained from mountainous areas. Formed by pouring self-compacting concrete into assembly of large rocks, the RFC is featured as a sustainable and environmentally friendly technology with consider-able reduced consumption of cement. It is different from conventional concrete dam, as RFC does not require cooling pipes for temperature control measures and eliminates the needs of vibration or roller compaction during concrete placement. These features make the RFC promising for broad applications in the construction of dams and other relevant civil infrastructure. The technology has gained significant attention among the engineering community in China and other regions, RFC technology is recognized as an innovative dam construction technique by the International Commission on Large Dams (ICOLD) who has a bulletin on this topic to be issued soon. To date, more than 100 RFC dams have been constructed or are under construction in China. Internally, several RFC dam projects are about to start in other countries including Pakistan and Burundi. Using rock-filled concrete for railway foundation backfill has also been recently studied by Turkish engineers.

(a)

(b)

Figure 1. Notable examples of completed RFC arch dams; (a) Lyutang RFC arch dam in Guizhou Province; (b) Baijia RFC double curvature arch dam in Shaanxi Province

Although arch dams have many salient features such as concrete-saving, cost-efficient and with excellent resistance to earthquake loading, compulsory primary cooling, secondary cooling and arch closure grouting make the construction process fairly complicated. There also exists many key challenges for the design of conventional arch dams. For example, it is difficult to maintain the construction efficiency of RFC, while probably minimising the effects of transverse joints as well as closure grouting. Supported by extensive fundamental research, Prof. Feng JIN's research group has made a breakthrough on the theoretical analysis of stress and temperature, structural detailing and construction techniques that have successfully tackled various engineering issues. These successes have constituted the innovative design and construction approach for an integral RFC arch dam.

Several signature completed RFC integral arch dam projects are shown in Fig. 1, while the RFC arch dams currently under construction are given in Fig. 2, including the Fengguang dam project (dam height, H=48.5m), Goujiang dam project (H=41m), Xiaoyuanli dam project (H=46.6m) and Longdongwan dam project (H=48m). More than 10 projects have been completed to successfully design and construct RFC arch dams, making the innovative RGC technology promising for broad applications in other earth structures such as arched retaining wall and anti-slide piles.

Fengguang RFC arch dam

Longdongwan RFC arch dam

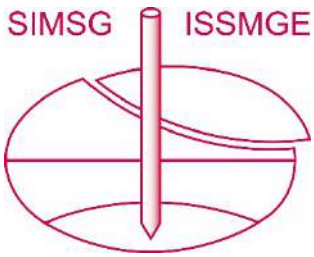
Goujiang RFC arch dam

Xiaoyuanli RFC arch dam

Figure 2. Some examples of RFC arch dams during construction

(ISSMGE Bulletin, Volume 14, Issue 3, June 2020, pp. 27-28, https://www.issmge.org/publications/issmge-bulletin/vol-14-issue-3-june2020)

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ



International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News & Information Circular June 2020
https://www.issmge.org/news/issmge-news-information-circular-june-2020

Upcoming Webinars

a. Prof. Luciano Picarelli - "The Classification of Landslides in Soils in a Mechanical Perspective" Launch date 3rd June 2020**,** 12:00pm GMT;

b. Prof. Fumio Tatsuoka – "Geosynthetics-Reinforced Soil Structures - Developments from Walls to Bridges" Launch date 10th June 2020, 12:00pm GMT

ISSMGE Awards

Member Societies are hereby called to submit nominations for ISSMGE awards for the 20th International Conference on Soil Mechanics and Geotechnical Engineering to be held in Sydney, Australia, in September 2021. Nominations should be submitted to the Secretary General by the closing date of 1 July 2020. For more information and guidelines for the nomination of the various awards please click **here**.

Bright Spark Lecture Award at Sydney ICSMGE 2021

The deadline for Bright Spark Lecture Award nominations has been extended to 1 August 2020. Two award recipients will be given the opportunity to give a keynote lecture at the 20th ICSMGE. More information can be found on: https://www.issmge.org/the-society/awards/bright-spark-lecture-award.

Corporate Associates Presidential Group:

The May 2020 update of Corporate Associates' varied and exciting activities around the world can be found here https://www.issmge.org/corporate-associates/corporate-associates-presidential-group. Why and how to join as a Corporate Associate are detailed in https://www.issmge.org/corporate-associates/why-how-to-join.

Message from the President:

We are all under the threat by the COVID-19 and have suffered and affected by it one way or the other. Many universities and training centres are closed. Many students and engineers may not be able to access and receive necessary education and training. This is a serious disruption to their future. However, the free ISSMGE's online "Virtual University" should be able to assist them while they are at home or under quarantine. We have developed seven full courses including:

Course 1: Risk-Mitigation, monitoring & Observational Methods
Course 2: In Situ Testing
Course 3: Earthquake Engineering
Course 4: Foundations
Course 5: Soil Characterization
Course 6: Geo-Engineering Education
Course 7: Unsaturated Soil Mechanics

In addition, there are many webinars available online. Please visit the ISSMGE website to find out more details as follows: http://virtualuniversity.issmge.org/

Please let whoever needs the education and training know in your countries and regions.

Bulletin

The latest edition of the ISSMGE Bulletin (Volume 14, Issue 2, April 2020) is available from the website: https://www.issmge.org/publications/issmge-bulletin/vol-14-issue-2-april-2020

ISSMGE Online Library – Open Access

The ISSMGE Online library (https://www.issmge.org/publications/online-library) is in continuous development – please note the following additions:

17th African Regional Conference on Soil Mechanics and Geotechnical Engineering;
17th European Conference on Soil Mechanics and Geotechnical Engineering,
Australia New Zealand conference series back catalogue,
XVI Pan-American Conference on Soil Mechanics and Geotechnical Engineering (XVI PCSMGE 2019)
9th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground, Sao Paulo, 2017 (TC204)

Are We Overdesigning? A survey of international practice

A joint initiative by the CAPG, the YMPG, TC2015 - Safety and Serviceability and TC304 - Risk. The survey is intended to assess the consistency of calculation models and design methods for a variety of geotechnical structures, and where possible, to compare the results with full scale tests and reliability analyses. To participate in the survey please go to https://www.issmge.org/news/are-we-overdesigning-a-survey-of-international-practice**.**

ISSMGE Foundation

The next deadline for receipt of applications for awards from the ISSMGE Foundation is the 30th September 2020. Click **here** for further information on the ISSMGE Foundation.

Conferences

For a listing of all ISSMGE and ISSMGE supported conferences, and full information on all events, including deadlines, please go to the Events page at https://www.issmge.org/events. However, for updated in-

formation concerning possible changes due to the corona-virus outbreak (ie. postponements, cancellations, change of deadlines, etc), please refer to that specific event's website.

The following are events that have been added/amended since the previous Circular:

ISSMGE Events

INTERNATIONAL CONFERENCE ON GEOTECHNICAL ENGINEERING EDUCATION - AN ONLINE EVENT -23-06-2020 - 25-06-2020
Streamed from Athens, Greece; Language: English; Organiser: TC306- Geo-engineering Education; Contact person: Marina Pantazidou; Email: gee2020athens@gmail.com; Website: https://www.gee2020.org;

7TH INTERNATIONAL YOUNG GEOTECHNICAL ENGINEERS CONFERENCE - 10-09-2021 - 12-09-2021
International Convention Centre, Sydney, Australia; Language: English; Organiser: Australian Geomechanics Society; Contact Information: ICMS Australasia, Address: Level 9, 234 George Street, Sydney NSW, 2000, Phone: (+61 2) 9254 5000, Email: info@icsmge2021.com: Website: http://icsmge2021.org/7iygec/

Non-ISSMGE Events

DFI DEEP MIXING 2021 - 05-07-2021 - 08-07-2021
(postponed from June 2020);
Polish Baltic Philharmonic and Congress Centre, Gdansk, Poland; Language: English; Organiser: Deep Foundations Institute, Contact person: Theresa Engler; Address: 326 Lafayette Avenue Phone: 9734234030, Fax: 9734234031, Email: tengler@dfi.org;
Website: http://www.dfi.org/DM2021

Geosynthetics-Reinforced Soil Structures - Developments from Walls to Bridges

Presenter: Prof. Fumio Tatsuoka
Launching Date & Time: June 10 2020 12:00pm GMT

https://www.issmge.org/education/recorded-webinars/geosynthetics-reinforced-soil-structures-developments-from-walls-to-bridges

The Classification of Landslides in Soils in a Mechanical Perspective

Presenter: Prof. Luciano Picarelli
Launching Date & Time: June 03 2020 12:00pm GMT

https://www.issmge.org/education/recorded-webinars/the-classification-of-landslides-in-soils-in-a-mechanical-perspective

2nd John Burland Lecture: Reflections on Some Contemporary Aspects of Geotechnical Engineering Education - From Critical State to Virtual Immersion

Presenter: Prof. Mark Jaksa
Launching Date & Time: June 23 2020 12:45pm GMT

https://www.issmge.org/education/recorded-webinars/2nd-john-burland-lecture-reflections-on-some-contemporary-aspects-of-geotechnical-engineering-education-from-critical-state-to-virtual-immersion

Forks in the Road: Rethinking Modeling Decisions that Defined Teaching and Practice of Geotechnical Engineering

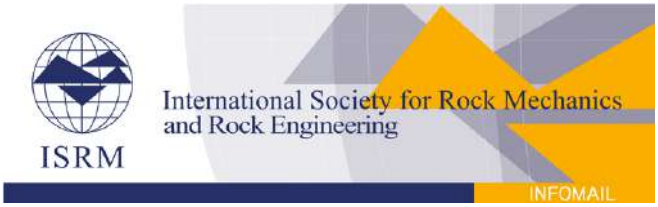
Presenter: Prof. Rodrigo Salgado
Launching Date & Time: June 23 2020 14:45pm GMT

https://www.issmge.org/education/recorded-webinars/forks-in-the-road-rethinking-modeling-decisions-that-defined-teaching-and-practice-of-geotechnical-engineering

Prior Knowledge, Learning A\and Common Instructional Practices Grounded in Evidence

Presenter: Prof. Susan A. Ambrose
Launching Date & Time: June 23 2020 12:00pm GMT

https://www.issmge.org/education/recorded-webinars/prior-knowledge-learning-and-common-instructional-practices-grounded-in-evidence



30th ISRM online lecture by Dr. Gen-Hua Shi on the 25th June

For the 30th ISRM Online Lecture the ISRM invited Dr. Gen-Hua Shi. The title of the lecture is "Contact Theory and Algorithms for Discontinuous Computations". The lecture was broadcasted on the 25th June and will remain available in the online lectures dedicated webpage.

Dr Gen-Hua Shi completed university studies in Mathematics Topology in 1963, in China, where he worked for several institutes on tunnelling and numerical methods. In 1980 he moved to the U.S.A., where he worked as a researcher at the UC Berkeley and the Lawrence Berkeley Laboratory. He obtained a PhD in Rock Mechanics from UC Berkeley in 1988, where he taught rock mechanics until 1994. From 1992 to 1997 Dr Shi was a research engineer at the U.S. Army Corps of Engineers Waterways Experiment Station (WES) in Vicksburg. Since the first years of the 21st century he holds the position of Technical Director at several research institutes in China. In 1997 he founded the DDA company, consulting in rock engineering and numerical methods, and he has been its chairman until the present.

Dr Gen-Hwa Shi received the Chinese National Award of Natural Science in 1982; the Basic Research Award for 1984, from the U. S. National Committee for Rock Mechanics, National Research Council, for the Significant Original Contribution to Research in Rock Mechanics; the Award for Significant Paper, 1994, in the Category Theory: Computational and Analytical International by IACMAG; and the FLC Award of Merit, 1995, for Excellence in the field of Technology Transfer, presented by the U.S. Federal Laboratory Consortium Southeast Region.

The precursor research work of Dr Gen-Hwa Shi covers: Block Theory, which is now a part of rock engineering classes in many institutes and a widely adapted practical method in rock excavations; Discontinuous Deformation Analysis (DDA), which can simulate movements of deformable block systems (annual meeting ICADD1 to ICADD10; Numerical Manifold Method (NMM); Simplex Integration; and Contact Theory, considering engineering block systems.

He wrote several books, which are now a reference in his field, namely "Block theory and its application to rock engineering" by R. Goodman and G.H. Shi (1985); "Block System Modeling by Discontinuous Deformation Analysis" by G.H. Shi (1993); "Numerical Manifold Method (NMM) and Discontinuous Deformation Analysis (DDA)" by G.H. Shi (1997); and "Discontinuous Deformation Analysis (DDA)" by J. Onishi, T. Sasaki and G.H Shi (2005).

The lecture will remain online so that those unable to attend at this time will be able to do it later. As usual, the attendees will be able to ask questions to the lecturer by e-mail during the subsequent five days. All online lectures are available from this page.

Young Members Group

Historical Tunnel Construction – Building tunnels in the 19th Century

Speaker: Peter Harris – Director COWI UK

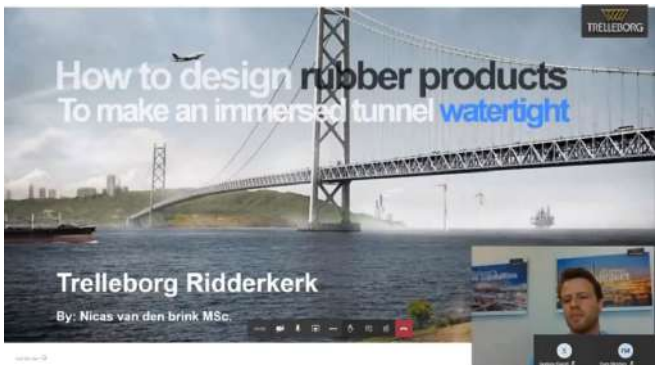
Online via YouTube
https://www.youtube.com/watch?v=cdvtecjM8pA&feature=youtu.be&_ccCt=6Cuwf_DFsico3PVxpw0NNeP4dq2PqHXljNzhdsanakV729ce02m9J4BLdDPXGoSX

The presentation will look at the system by which tunnels were built in the 19th Century following the traditional English method. It will include illustrations based on F.W. Simms 'Practical Tunnelling' for his work at Bletchingley and Saltwood tunnels, C. Gripper and Thomas Walker on the Severn Tunnel and from several other tunnels now belonging to Network Rail. It will show elements of the setting out and sinking of shafts, driving a heading, opening out the main tunnel and lining it and will end by describing some typical tunnel features.

How to design rubber products to make an Immersed Tunnel watertight

Tunnelling Association of India Young Members and BTYSYM jointly hosted **Nicas van den Brink** (Design Engineer, Trelleborg Ridderkerk BV) for a lunch and learn webinar on Tuesday 23 June 2020.

Immersed tunnelling has been around for a long time and is a perfect example of how Rubber, Steel and Concrete complement each other.



Rubber is a unique material with unique properties perfectly suited for creating watertight joints over a long period of time.

This presentation is about how to design a rubber product that can solve the most demanding technical challenges - What to consider and what to know before a solution is made and practically applied.

The talk will cover the history of immersed tunnelling and address the specific challenges rubber has in the field of sealing, both in the short and long terms.

As an example Nicas will go through the process of designing, testing and applying seals for an immersed tunnel.

Streaming Link : https://youtu.be/3jvTOcA8-Ys

CHINESE NATIONAL COMMITTEE ON LARGE DAMS

Dear Colleagues,

Greetings from Chinese National Committee on Large Dams (CHINCOLD). Welcome to visit CHINCOLD Cloud Platform at http://www.chincold-smart.com/en .

Through months efforts of checking official data worldwide, CHINCOLD systematizes two dam information inquiry systems:

Top 100 dams worldwide classified by height (2020)

Top 100 dams worldwide classified by storage capacity (2020)

In either system, dams can be filtered by river, dam type, height and storage capacity, as well as be listed in the order ofB height, river, country, storage capacity and installed capacity. This month, we recommend these **dam charts**. The information is open and free to all the dam experts over the world.

Top 100 Dams Worldwide Classified by Height (Statistics in 2020)

http://www.chincold-smart.com/en/wisdom-lib/liter/stat/inter-stat/world-stat-list/stat-inter-height

No.	Name	Country	River	TYPE (*)	Height (m)	Storage Capacity ($10^6 m^3$)	Installed Capacity (MW)	Year of completion
1	Rogun	Tajikistan	Vakhsh	TE	335	13300	1200	Under construction
2	Shuangjiangkou	China	Dadu River	ER	314	3115	2000	Under construction
3	Jinping I	China	Yalong River	VA	305	7988	3600	2014
4	Nurek	Tajikistan	Vakhsh	TE	300	10500	2700	1980
5	Lianghekou	China	Yalong River	ER	295	10767	3000	Under construction
6	Xiaowan	China	Lancang River	VA	294.5	15000	4200	2012
7	Baihetan	China	Jinsha River	VA	289	20600	16000	Under construction
8	Xiluodu	China	Jinsha River	VA	285.5	12670	13860	2015
9	Grande Dixence	Switzerland	Dixence	PG	285	400	2069	1962
10	Kambarazin-I	Kyrgyzstan	Нарын	TE	275	3600	1900	1996
11	…	…	…	…	…	…	…	…

Top 100 Dams Worldwide Classified by Storage Capacity (Statistics in 2020)

http://www.chincold-smart.com/en/wisdom-lib/liter/stat/inter-stat/world-stat-list/stat-inter-storage

No.	Name	Country	River	TYPE (*)	Height (m)	Storage Capacity ($10^6 m^3$)	Installed Capacity (MW)	Year of completion
1	Kariba	Zambia,Zimbabwe	Zambezi	VA	128	180600	1500	1976
2	Bratsk	Russian Federation	Angara	PG	125	169000	4500	1964
3	Aswan	Egypt	Nile	ER	111	162000	2100	Under construction
4	Akosombo	Venezuela	Volta	ER	134	150000	1020	1965
5	Daniel Johnson	Canada	Manicouagan	VA	214	141850	2656	1965
6	Guri	Venezuela	Caroni	PG	162	135000	10235	1986
7	W.A.C.Bennett	Canada	Peace	TE	183	74300	2730	1967
8	Krasnoyarsk	Russian Federation	Yenisey	PG	124	73300	6000	1972
9	Zeya	Russian Federation	Zeya	PG	115	68400	1330	1978
10	La Grande II	Canada	La Grande	ER	168	61720	7722	1992
11	…	…	…	…	…	…	…	…

(*) TE: earth fill, ER: rock fill, PG: concrete gravity, VA: arch

If there are errors or additions, please feel free to give your comments or suggestions in the cooperation section of the platform http://www.chincold-smart.com/en/wisdom-lib/co-operation/all/list/1.

ΠΡΟΣΦΟΡΕΣ ΕΡΓΑΣΙΑΣ

Position available on Earthquake Engineering and Seismology (Junior/ Experienced Researcher)

The Historical and Masonry Structures (HMS) group of the Institute for Sustainability and Innovation in Structural Engineering (ISISE), University of Minho, Portugal, plans to open soon a position for a junior or experienced researcher already with a PhD (duration of the contract may be up to 4 years) to join the STAND4HERITAGE project, which is funded by a European Research Council Advanced Grant.

The position will focus on the stochastic analysis of the seismic signal with the aim to generate a representative variation of ground motion records (both source and structure-sensitive), and to examine the influence of the signal on the dynamic (seismic) behaviour of masonry structures.

Necessary qualifications: PhD degree in Civil Engineering or Earthquake Engineering with a strong background in stochastic analysis and geophysics, or similar qualifications.

If interested, please send your résumé to Dr Anastasios Giouvanidis (agiouvanidis@civil.uminho.pt) until Sunday, August 23rd (23:59 GMT).

Paulo B. Lourenço

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

Για τις παλαιότερες καταχωρήσεις περισσότερες πληροφορίες μπορούν να αναζητηθούν στα προηγούμενα τεύχη του «περιοδικού» και στις παρατιθέμενες ιστοσελίδες.

SSA Seismological Society of America

BSSA Call for Papers: Special Section on Fault Displacement and Near-Source Ground Motion Models

The *Bulletin of the Seismological Society of America* (BSSA) solicits papers for a Special Section on Fault Displacement and Near-Source Ground Motion Models.

Reliable quantification of ground motions proximal to the source, and fault displacement caused by surface rupturing are primary concerns for site-specific Seismic Hazard Analyses (SHA) and Fault Displacement Hazard Analyses (FDHA). Such analyses are crucial for critical infrastructure projects near or crossing active faults such as nuclear power plants, nuclear waste repositories, pipelines, high-rise buildings, long-span bridges, chemical plants, dams, etc. These hazard analyses require integration of the best available information about how surface rupture, near-fault ground motions and permanent ground displacements are controlled by region-specific geology, site effects, seismic sources and near-source propagation. The development of reliable empirical models to predict fault displacement and near-source ground motion based on observations from damaging earthquakes is hampered because of the sparseness of observed data. However, recent observations of fault displacement and very near-source ground motion, and recent advances of physical models have revealed complex, source-dominated phenomena beyond what current empirical predictive models capture. The purpose of this special issue is to summarize and explore these issues, and quantify uncertainties so that engineering solutions are based on sound physical models and/or robust empirical characterizations.

We invite papers summarizing the developments of fault displacement and very-near source ground motion models, as well as summaries and analyses of observations in recent earthquakes. The scaling of near-source motions and fault displacements over a range of magnitude scales from moderate to large is of interest. Within these mentioned topics, we welcome studies that: summarize the state-of-the-art in modeling research, technology and practices; present or interpret important empirical datasets; describe current issues, present innovative new models or propose engineering solutions for applications in SHA and FDHA; or demonstrate how to turn research findings into practical applications. Studies that address the uncertainty quantification from a range of disciplines are very welcome. The dissemination of science solutions into practice of SHA, FDHA and engineering problems with the uncertainties fully considered is our final goal.

The guest editors for this special issue are:

Luis A. Dalguer (3Q-Lab GmbH, Switzerland)
Steven Day (San Diego State University, USA)
Gail Atkinson (University of Western Ontario, Canada)
Rui Chen (California Geological Survey, USA)

The deadline for submission of manuscripts is 15 February 2021.

Papers submitted in advance of the deadline will be reviewed as they are received and published online soon after they are accepted for publication, in advance of the print issue, which is scheduled for October 2021. In preparing manuscripts, authors must follow BSSA's author guidelines at https://www.seismosoc.org/publications/bssa-submission-guidelines/. Papers must be submitted via BSSA's online submission system (www.edmgr.com/bssa).

Please address questions about scientific issues to Luis A. Dalguer at luis.dalguer@alumni.ethz.ch or to Thomas Pratt, BSSA Editor-in-Chief, at bssaeditor@seismosoc.org. Submission-related questions should be addressed to Betty Schiefelbein, Manuscript Coordinator, at bssamss@seismosoc.org.

https://www.seismosoc.org/publications/bssa/bssa-call-for-papers-special-section-on-fault-displacement-and-near-source-ground-motion-models/

5th Annual Urban Underground Space & Tunnelling conference, 20th – 22nd July 2020, Singapore, www.me-assets.com/HTMLEmail/AS-IF5361%20-%20Flyer.pdf

3rd International Conference on Geotechnical Engineering (ICGE – Colombo -2020), 10 - 11 August 2020, Colombo, Sri Lanka, http://icgecolombo.org/2020/index.php

WTC 2020 ITA-AITES World Tunnel Conference, September 2020, Kuala Lumpur, Malaysia, www.wtc2020.my
ITA and IEM hereby jointly announce that WTC2020 in Kuala Lumpur, Malaysia scheduled from 11th to 17th September 2020 will be moved to a fully digital platform due to the impacts of COVID19, including border restrictions and health risks associated with international travel and the assembly of large meetings.

RTG²EE - Recent Trends in Geotechnical and Geo-Environmental Engineering and Education, Online Conference, 10 – 11 September 2020, Bali, Indonesia, https://rtgee.org

ACE 2020 14th International Congress on Advances in Civil Engineering, 16-18 September 2020, Istanbul, Turkey, www.ace2020.org/en

Fourth International DAM WORLD Conference, 21-25th September 2020, Lisbon, Portugal, https://dw2020.lnec.pt

Cities on Volcanoes 11 - Volcanoes and Society: environment, health and hazards, 25-30 September 2020, Heraklion, Crete, https://pcoconvin.eventsair.com/volcanoes11

EUROCK 2020 Hard Rock Excavation and Support, 12-14 October 2020, Trondheim, Norway, www.eurock2020.com

E-UNSAT 2020 4th European Conference on Unsaturated Soils - Unsaturated Horizons, 19 to 21 October 2020, Lisbon, Portugal, https://eunsat2020.tecnico.ulisboa.pt

GEO-EXPO 2020 Scientific and Expert Conference, 22-23 October 2020, Prijedor, Bosnia and Herzegovina www.geotehnika.ba

HYDRO 2020 Strategies for future progress, 24-28 October 2020, Strasbourg, France, www.hydropower-dams.com/hydro-2020

GeoAmericas2020 4th Pan American Conference on Geosynthetics, 26-29 October 2020, Rio de Janeiro, Brazil, www.geoamericas2020.com

5th Symposium of the Macedonian Association for Geotechnics, 29-31 October 2020, Ohrid, North Macedonia, mag@gf.ukim.edu.mk

3rd Conference of the Arabian Journal of Geosciences (CAJG), 2-5 November 2020, Sousse, Tunisia, https://cajg.org

5TH World Landslide Forum Implementation and Monitoring the USDR-ICL Sendai Partnerships 2015-2015, 2-6 November 2020, Kyoto, Japan, http://wlf5.iplhq.org

Fourth GeoMEast©2020 International Underground Structures Conference (IUSC), 8-12 November 2020, Cairo, Egypt, http://underground.geomeast.org

CouFrac 2020 - International Conference on Coupled Processes in Fractured Geological Media: Observation, Modeling, and Application, November 11-13, 2020, Seoul, Korea, http://coufrac2020.org

10th International Conference on Scour and Erosion (ICSE-10), November 15-18, 2020, Arlington, Virginia, USA, www.engr.psu.edu/xiao/ICSE-10 Call for abstract.pdf

88th ICOLD Annual Meeting & Symposium on Sustainable Development of Dams and River Basins, 28-November to 3-December 2020, New Delhi, India, https://www.icold2020.org

ASIA 2020 Eighth International Conference and Exhibition on Water Resources and Renewable Energy Development in Asia, 8-10 December 2020, Kuala Lumpur, Malaysia, www.hydropower-dams.com/asia-2020

6th ICFGE 2020 Forensic Geotechnical Engineering & Geo-Disaster Documentation, December 10-12, 2020 IIT Delhi, India, http://tc302-issmge.com

27th European Young Geotechnical Engineers Conference and Geogames, 17 – 19 December 2020, Moscow, Russia, https://t.me/EYGEC2020

ARMS11 11th Asian Rock Mechanics Symposium, Challenges and Opportunities in Rock Mechanics, 2021, Beijing, China, www.arms11.com

ISGPEG 2020 International Conference on Innovative Solutions for Geotechnical Problems in Honour of Prof. Erol Guler, 2021, Istanbul, Turkey, www.isgpeg2020.org/en

14th Baltic Sea Geotechnical Conference 2020 Future Challenges for Geotechnical Engineering, 18-20 January 2021, Helsinki, Finland, www.ril.fi/en/events/bsgc-2020.html

Nordic Geotechnical Meeting Urban Geotechnics, 18-20 January 20210, Helsinki, Finland, www.ril.fi/en/events/ngm-2020.html

PanAm Unsat 2021 3rd Pan-American Conference on Unsaturated Soils, 25-28 January 2021, Rio de Janeiro, Brazil, https://panamunsat2021.com

XIII International Symposium on Landslides - Landslides and Sustainable Development, 21-26 February 2021, Cartagena, Colombia, www.scg.org.co/xiii-isl

2021 GEOASIA7 - 7th Asian Regional Conference on International Geosynthetics Society, March 1-4, 2021, Taipei, Taiwan, www.geoasia7.org

3rd International Symposium on Coupled Phenomena in Environmental Geotechnics, 17 – 19 March 2021, Kyoto, Japan, https://cpeg2020.org

ICEGT-2020 2nd International Conference on Energy Geotechnics, 28-31 March 2021, La Jolla, California, USA, https://icegt-2020.eng.ucsd.edu/home

International Conference on Challenges and Achievements in Geotechnical Engineering
31.03.2021 – 02.04.2021, Tirana, Albania

Organiser: Albanian Geotechnical Society
Contact person: Erdi Myftaraga
Phone: +355699336911
Email: emy@greengeotechnics.com

EUROENGEO 3RD EUROPEAN REGIONAL CONFERENCE OF IAEG, 8 - 12 April 2021, Athens, Greece, www.euroengeo2020.org

AFRICA 2021 Water Storage and Hydropower Development for Africa, 13-15 April 2021, Lake Victoria, Uganda, www.hydropower-dams.com/africa-2021

2nd Vietnam Symposium on Advances in Offshore Engineering
22-24 April 2021, Ho Chi Minh City, Vietnam
https://vsoe2021.sciencesconf.org

Following the success of the first Vietnam Symposium on Advances in Offshore Engineering (VSOE2018), we are pleased to announce that the second Symposium, VSOE2021, will be

held in Ho Chi Minh City, Vietnam, on 22-24 April 2021. The second VSOE event is being organised by the Association of Vietnamese Scientists and Experts (AVSE Global) in collaboration with Ho Chi Minh City University of Technology (HCMUT) and the Vietnam Administration of Seas and Islands (VASI).

Focusing on the theme of "**Sustainable Energy and Marine Planning**", VSOE2021 aims to enhance the sustainable use of our marine resources while ensuring the health of the ecosystem as well as the effective management of marine activities including energy production and infrastructures.

VSOE2021 continues providing a platform for all participants to exchange knowledge and experience gained recently in offshore engineering, technology innovations, and marine spatial plan to achieve the goal of economic, reliable and sustainable solutions for offshore energy development, and ecosystem-based management of the marine environment.

VSOE2021 intends to bring together researchers, practitioners, policymakers, and entrepreneurs to discuss and promote technology and policy changes toward renewable energy, as well as to generate business opportunities in offshore energy, both domestically in Vietnam and globally.

The Symposium program will include paper presentations, posters and project demonstrations, along with prominent keynote speakers, researchers, academics and technologists from leading universities, research firms, policymakers, entrepreneurs and practitioners.

All submitted papers will be reviewed by experts in the field based on the criteria of originality, significance, quality and clarity. The proceedings of the Symposium will be published by **Springer**, indexed by **Scopus** and EI Compendex database. The VSOE2018 proceedings are available here.

Topics

The main topics of the Symposium include, but are not limited to:

- Site Characterization and Ground Modelling (SCGM)
- Design of Offshore Foundations and Structures (DOFS)
- Performance of Offshore Foundations and Structures (POFS)
- Life Extension and Decommissioning of Offshore Facilities (LEDOF)
- Fossil Energy: Technology Opportunities and Challenges (FETOC)
- Offshore Renewable Energy Systems (ORES)
- Marine Spatial Planning (MSP)
- Design Standards, Risk and Reliability (DSRR)

Contact

Email: **vsoe@avseglobal.org**
For further information:
https://vsoe2021.sciencesconf.org

16th International Conference of the International Association for Computer Methods and Advances in Geomechanics – IACMAG - CHALLENGES and INNOVATIONS in GEOMECHANICS, 03-05 2021, Torino, Italy, www.symposium.it/en/events/2020/16th-international-conference-of-iacmag?navbar=1

EUROGEO WARSAW 2020 7th European Geosynthetics Congress, 16-19 May 2021, Warsaw, Poland, www.eurogeo7.org

WTC 2021 World Tunnel Congress 2021 - Underground solutions for a world in change, 16-19 May 2021, Copenhagen, Denmark, www.wtc2021.dk

TISOLS Tenth International Symposium on Land Subsidence, Living with Subsidence, 17-21 May 2021, Delft - Gouda, the Netherlands, www.tisols2020.org/tisols2020

7th International Conference on Industrial and Hazardous Waste Management 18 - 21 May, 2021, Chania, Crete, Greece, http://hwm-conferences.tuc.gr

2020 CHICAGO International Conference on Transportation Geotechnics, May 23 - 26, 2021, Chicago, Illinois, USA, http://conferences.illinois.edu/ICTG2020

Joint meeting of ISSMGE TC201 and TC210, ICOLD TC E and TC LE "Dams and Levees: Particle Movements – Case Studies, Experiments, Theory", June, 2020, Budapest, Hungary, www.isc6-budapest.com

6th International Conference on Geotechnical and Geophysical Site Characterization "Toward synergy at site characterisation", June 2021, Budapest, Hungary, www.isc6-budapest.com

2021 ICOLD MARSEILLE - ICOLD 27th Congress - 89th Annual Meeting Sharing Water: Multipurpose of Reservoirs and Innovations, 4 - 11 June 2021, Marseille, France, https://cigb-icold2021.fr/en/

MSL 2021 The 1st Mediterranean Symposium on Landslides SLOPE STABILITY PROBLEMS IN STIFF CLAYS AND FLYSCH FORMATIONS, 7-9 June 2021, Naples, Italy, https://medsymplandslides.wixsite.com/msl2021

9th International Conference on Computational Methods for Coupled Problems in Science and Engineering (COUPLED PROBLEMS 2021), 13-16 June 2021, Sardinia, Italy, coupledproblems_sec@cimne.upc.edu

EGRWSE 2020 - 3rd International Conference on Environmental Geotechnology, Recycled Waste Materials and Sustainable Engineering, 17-19 June 2021, Izmir, Turkey, www.egrwse2020.com

2nd ICPE 2021 The Second International Conference on Press-in Engineering, 19-21 June 2021, Kochi, Japan, https://icpe-ipa.org/

EUROCK TORINO 2021 - ISRM European Rock Mechanics Symposium Rock Mechanics and Rock Engineering from theory to practice, 21-25 June 2021, Torino, Italy, http://eurock2021.com

1st International Conference on Sustainability in Geotechnical Engineering, ICSGE, 27-30 June 2021, Lisboa, Portugal, http://icsge.lnec.pt/#

IS-Cambridge 2020 10th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground, 28 June to 01 July 2021, Cambridge, United Kingdom, www.is-cambridge2020.eng.cam.ac.uk

3rd International Conference on Natural Hazards & Infrastructure
22 – 24 June 2021, Athens, GREECE
https://iconhic.com/2021

ICONHIC2021: THE STEP FORWARD

"Alone we can do so little, together we can do so much" – Helen Keller, 1888

Ever–increasing Natural Disasters

ICONHIC's motto sounds more timely than ever, as plenty of our infrastructure systems at their present state are at high risk of not sustaining the extreme loading conditions imposed by natural disasters. The situation is exacerbated by the apparent deficiency of resources for maintenance or upgrading, while our planet is experiencing the roughest ecological disruption in its history, from climate change to biodiversity loss, and acute hazards, such as heatwaves and floods, grow in frequency and severity, while chronic hazards, such as drought and rising sea levels, intensify.

Join forces towards a resilient and sustainable future

The idea that the solution does not lie in a single discipline has already found consensus amongst the scientific community. It is of utmost importance to try to understand each other: engineers have to understand what financial experts are putting forward, technology developers need to conceptualize how the insurance industry can benefit from their novel applications, researchers should be aware of the practical needs of contractors.

ICONHIC sets the stage for engineers, researchers, cat modelers, insurers, policymakers and NGO-representatives to join forces, exchange ideas and opinions, advance scientific and technical innovations targeted at natural disasters, and ultimately converge their specialty knowledge towards a unified approach to a more sustainable and resilient future.

ICONHIC Conferences

Founded in 2016, the conference emerged in response to the ever-growing need for a landmark event that will gather together a broad field of expertise, aiming to prevent and reduce the risk of extreme natural events and their aftermaths on infrastructure. Sponsored by international industrial partners and institutions, who worked hand-in-hand with the academia to deliver an event that fosters collaboration between different stakeholders, ICONHIC2016 and ICONHIC2019 attracted a large number of attendees from all over the world, coming from exceptionally diverse technical or business backgrounds, with one overarching goal: to prepare within the constantly changing and highly uncertain environmental conditions and develop future-ready societies, able to reduce risk & manage disruption.

Following its evolution philosophy, the ICONHIC 2021 edition ventures the step forward: to build upon facilitative dialogue and strong synergies and propose an informed and realistic course of action against catastrophic natural events.

Join the discussion in Athens on 22-24 June 2021!

CONFERENCE HIGHLIGHTS

CREATING A MULTI-STAKEHOLDER MEETING POINT

In a time of augmented need for interdisciplinary effort, ICONHIC2021 aims to bring together actors from different fields (engineers, insurers, cat modellers, policymakers, NGOs) in order to facilitate dialogue and shape an informed course of action towards the ever-increasing extreme natural events.

LEVERAGING ARTIFICIAL INTELLIGENCE TO MITIGATE NATURAL DISASTERS

In light of the rapid technological advances in the fields of Big Data, Machine Learning, and Unmanned Aerial Systems (UAS), ICONHIC2021 aims to highlight how this technology combined with engineering knowledge can become the decisive link in the action chain towards disaster relief, preparedness and reduction of economic losses due to natural hazards.

SHAPING URBAN SUSTAINABILITY REQUIREMENTS

As countries across the globe become increasingly urbanized, ICONHIC2021 targets the appropriate synergies for an in-depth discussion on the pathways to be followed for encouraging investments and informing management decisions towards sustainable urban environments.

CONFERENCE THEMES

EARTHQUAKES & LANDSLIDES

- Engineering Seismology & Ground Motion Simulation Assessment, Analysis and Retrofitting of Structures
- Aging Infrastructure and Future Earthquakes: Concrete, Steel and Masonry Structures
- Isolation and Energy Dissipation Devices
- Instrumentation & Structural Health Monitoring
- High-risk Facilities exposed to Induced Seismicity
- Seismic Design of Foundations and Underground Structures
- Soil-Structure Interaction
- Ground Failure & Liquefaction: Analysis and Effects on Structures and Lifelines
- Protection of Historical Structures against Seismic Hazards
- Landslides Prevention and Mitigation: Design Practice and New Concepts
- Offshore Landslides and Effects on Submarine Structures and Pipelines
- Earthquake/ Rainfall-induced Landslides: Analysis and Modelling

FLOODS, WINDSTORMS & WILDFIRES

- Flood Risk Management and Risk Reduction Strategies
- Flood Forecasting, Modelling and Flood Control
- Natural & Engineered Defences & Vulnerabilities
- Urban Drainage Infrastructure and Performance
- Dikes, Levees and Dams: studying Failures and proposing Strategic Solutions
- Storm Surges, Tsunamis and Sea Level Rise
- Strong Winds, Hurricanes, Cyclones, Tropical Storms
- Drought impacts on Infrastructure Service Delivery
- Wildfire Modelling & Risk Analysis
- Seasonal Hazards: Extreme Cold and Heatwaves

USING NEW TECHNOLOGY TO MITIGATE NATURAL DISASTERS

- Assessment of Natural Hazards from Satellite Imagery, Drones, and Wireless Sensing Networks
- Robotics and Automation in Natural Disasters Management: Challenges and Opportunities
- Big Data Frameworks for Monitoring and Modelling Infrastructure Performance
- Convergence of AI-based tools in the Response of Complex Systems
- Multi-Risk Decision Support Methodologies
- Integrating Disaster Risk into Life-Cycle Management of Infrastructure Systems
- Multi-scale Modelling of Natural Hazards

SUSTAINABILITY IN THE URBAN ENVIRONMENT

- Blue-Green Solutions for Sustainable Urban Development
- Bio-inspired Construction Materials
- Air Pollution & Noise Mitigation Strategies
- Innovative Materials for Infrastructure Protection against Natural Hazards
- Climate Change-induced Swift in Global Risk Landscape
- Modelling, Regulations and Initiatives on Climate Change
- Exposure of Renewable Energy Infrastructure to Natural Hazards
- Social Science and Extreme Events: building Connections among Communities affected by Disaster

Contact us

The 2nd International Conference on Natural Hazards & Infrastructure
ICONHIC Co.
Kritis 12, 15235 Athens, GREECE
Tel. +30 210 6721798
email: secretary@iconhic.com

DFI Deep Mixing, 5-8 July 2020, TBD, Gdansk, Poland, www.dfi.org/DM2020

July 12 – 14, 2021, Lima, Peru
www.geoingenieria.org.pe

Event Description

This second edition is aimed at sharing the design processes, operation, maintenance, monitoring and closure of waste rock and tailings. This edition will feature local and international renowned keynote speakers who will analyze, share experiences and enhance the professional development of the sector.

TOPICS

- Failure analysis in tailings dam
- Mine waste closures
- Tailings deposit
- Waste rock design
- Dynamic and Static liquefaction
- Basic studies for tailings design
- Geochemistry of mine waste
- Geosynthetics
- Tailings management
- Risks
- Tailings transportation
- New tailings technologies
- Economic assessment of mine waste projects (*)

Reports and Registration

- Phone: 941 717905
- Email: geoingenieria@speg.org.pe
- Email: patricia@geoingenieria.org.pe

7th ICRAGEE International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, 12-17 July 2021, Bengaluru, India, http://7icragee.org

GEOCHINA 2021 - 6th GeoChina International Conference Civil & Transportation Infrastructures: From Engineering to Smart & Green Life Cycle Solution, July 19 to 21, 2021, Nan-Chang, China, http://geochina2021.geoconf.org

37th General Assembly of the European Seismological Commission, September 2021, Corfu, Greece, www.escgreece2020.eu

RMEGV 2021

5th International Workshop on Rock Mechanics and Engineering Geology in Volcanic Fields
9÷11 September 2021, Fukuoka, Japan
https://ec-convention.com/rmegv2021

On behalf of the Japanese Society for Rock Mechanics and the Japan Society of Engineering Geology, we are pleased to hold "RMEGV2021: 5th International Workshop on Rock Mechanics and Engineering Geology in Volcanic Fields". The goals of this workshop are to promote the exchange of ideas and information among civil engineers and geologists regarding serious issues related to volcanic fields, and to find possible solutions to them, as well as to aid in the fusion of Civil Engineering and Geology in terms of applied volcanic science, including construction, environment, groundwater, disasters, and geothermal energy. Many resources can be found in the vicinity of volcanic fields, such as hydro-geothermal energy and groundwater. On the other hand, many natural disasters and other risks to infrastructure construction also exist due to the geoscientific and geotechnical features in these areas. Thus, civil engineers and engineering geologists strive to solve these problems based on the existing data on volcanic fields. The themes of this workshop include volcanic geology, disasters and their mitigation, resources and energy in volcanic fields, mechanical behavior of volcanic rocks and soils, groundwater and environmental problems in volcanic fields, and geotechnical engineering in volcanic fields. It is our hope that many researchers/engineers involved in applied volcanic science will attend this workshop from all over the world, participate in deeply meaningful discussions, and create new global research connections.

Theme

Challenges of Solving Engineering Issues around Volcanic Fields - Collaboration between Civil Engineering and Geology

Topics

- Volcanic geology
- Disasters and their mitigation in volcanic fields
- Resources and energy in volcanic fields
- Mechanical behavior of volcanic rocks and soils
- Groundwater and environmental problems in volcanic fields
- Geotechnical engineering in volcanic fields

Contact

Secretariat Office

Takehiro OHTA, Secretariat
E-mail: rmegv2021@rocknet-japan.or

SYDNEY 7iYGEC 2021 7th International Young Geotechnical Engineers Conference A Geotechnical Discovery Down Under, 10-12 September 2021, Sydney, Australia, http://icsmge2021.org/7iygec

SYDNEY ICSMGE 2021 20th International Conference on Soil Mechanics and Geotechnical Engineering, 12-17 September 2021, Sydney, Australia, www.icsgme2021.org

International Conference on Textile Composites and Inflatable Structures (MEMBRANES 2021), 13-15 September 2021, Munich, Germany , https://congress.cimne.com/membranes2021/frontal/default.asp

GeoAfrica 2021 - 4th African Regional Conference on Geosynthetics Geosynthetics in Sustainable Infrastructures and Mega Projects, 11-14 October 2021, Cairo, Egypt, https://geoafrica2021.org

ISFOG 2020 4th International Symposium on Frontiers in Offshore Geotechnics, 8 – 11 November 2021, Austin, United States, www.isfog2020.org

LARMS 2021 – IX Latin American Rock Mechanics Symposium Challenges in rock mechanics: towards a sustainable development of infrastructure, 15 – 18 May 2022, Asuncion, Paraguay, https://larms2021.com

Eurock 2022

Rock and Fracture Mechanics in Rock Engineering and Mining
13÷17 June 2022, Helsinki, Finland

Contact Person: Lauri Uotinen
E-mail: lauri.uotinen@aalto.fi

3rd European Conference on Earthquake Engineering and Seismology (3ECEES), 19-24 June 2022, Bucharest, Romania, https://3ecees.ro

9th International Congress on Environmental Geotechnics
Highlighting the role of Environmental Geotechnics in Addressing Global Grand Challenges
26-29 June 2022, Chania, Crete island, Greece
www.iceg2022.org

The 9th International Congress on Environmental Geotechnics is part of the well established series of ICEG. This conference will be held on an outstanding resort in the town of Chania of the island of Crete in Greece. The theme of the

conference is "Highlighting the role of Environmental Geotechnics in Addressing Global Grand Challenges" and will highlight the leadership role of Geoenvironmental Engineers play on tackling our society's grand challenges.

Contact Information

- Contact person: Dr. Rallis Kourkoulis
- Email: rallisko@grid-engineers.com

UNSAT2022
8th International Conference on Unsaturated Soils
June or September 2022, Milos island, Greece

5th International Symposium on Cone Penetration Testing (CPT'22)
26-29 June 2022, Bologna, Italy

Organiser : Italian Geotechnical Society (AGI) and University of Bologna (endorsed by TC102)

Contact person: Susanna Antonielli (AGI), Prof. Guido Gottardi (University of Bologna)

Email: guido.gottardi2@unibo.it
Email: agi@associazionegeotecnica.it

XII ICG - 12th International Conference on Geosynthetics, September 18 – 22, 2022, Rome, Italy, www.12icg-roma.org

15th ISRM

International Congress in Rock Mechanics
9÷14 October 2023, Salzburg, Austria

Contact Person: Prof. Wulf Schubert
E-mail: salzburg@oegg.at

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Major Landslide Destroys 8 Homes In Northern Norway

Eight houses were swept into the sea by the powerful landslide in northern Norway

A powerful landslide of more than 2,000 feet in width has taken eight houses into the sea in northern Norway. The instability continued for several hours and one person was evacuated from a nearby property, but there have been no reports of injuries.

Incredibly powerful landslide caught on camera

The landslide of more than 2,000 feet wide and 500 feet high occurred on the western side of Kråkneset in Alta municipality on Wednesday afternoon. The police were notified of the incident at 3.45pm and a rescue operation was immediately launched by air and sea.

A local managed to capture some of the event on camera. The video, featured in Altaposten, shows the sheer power of the land movement. One local described how he heard a bang in the loft of his cabin and assumed someone was in the building. "I ran for my life," he said, once the situation became clear.

https://www.youtube.com/watch?v=6QcBSbQo4XA&feature=emb_logo

Rescue operation over

Although police were unable to enter the area by land due to ongoing instability, the rescue operation was called off at 7pm with everyone accounted for. Police are now verifying the information received to confirm that no-one is left in the area.

Many of the buildings are holiday homes, which would have likely been fully occupied during the public holiday just 48 hours beforehand.

The incredible scar in the landscape left by the landslide in northern Norway

On-duty commander Sten-Rune Nikolaisen from the Main Rescue Centre reported to NRK that the Sea King helicopter returned to base just before 7pm. "They have searched visually and using camera equipment. No discoveries have been made," said Nikolaisen.

Land remains highly unstable

According to local media reports, several smaller landslides occurred in the hours following the main incident. The Norwegian Water Resources and Energy Directorate (NVE) is monitoring the situation, in particular the risk of more landslides.

NVE district engineer Anders Bjordal warned that there is likely to be ongoing movement for a couple of days.

(David Nikel - Senior Contributor / Forbes, Jun 3, 2020, https://www.forbes.com/sites/davidnikel/2020/06/03/major-landslide-destroys-8-homes-in-northern-norway/#1d74f78a4419)

Quick Clay Landslide

Just now in Alta, Norway: Huge mudslide dragging several houses into the sea. June 3, 2020

There was a dog that joined the ride, but he was able to swim back to shore and get rescued.

(https://twitter.com/JanFredrikD/status/1268270255509512193?fbclid=IwAR0mBQee-OXs_zsazFK0SpSd6jJnQl5BaROZH_ESqOo1-3TcrSlhbX7VjDAw)

Here's an older, but much more dramatic event.

The Quick Clay Landslide at Rissa - 1978

On the 29th of April 1978, a quick clay landslide devastated large areas of the rural district of Rissa I mid-Norway. One person died whilst 13 farms; 2 homes; a cabin and a community centre were taken by the clay masses.

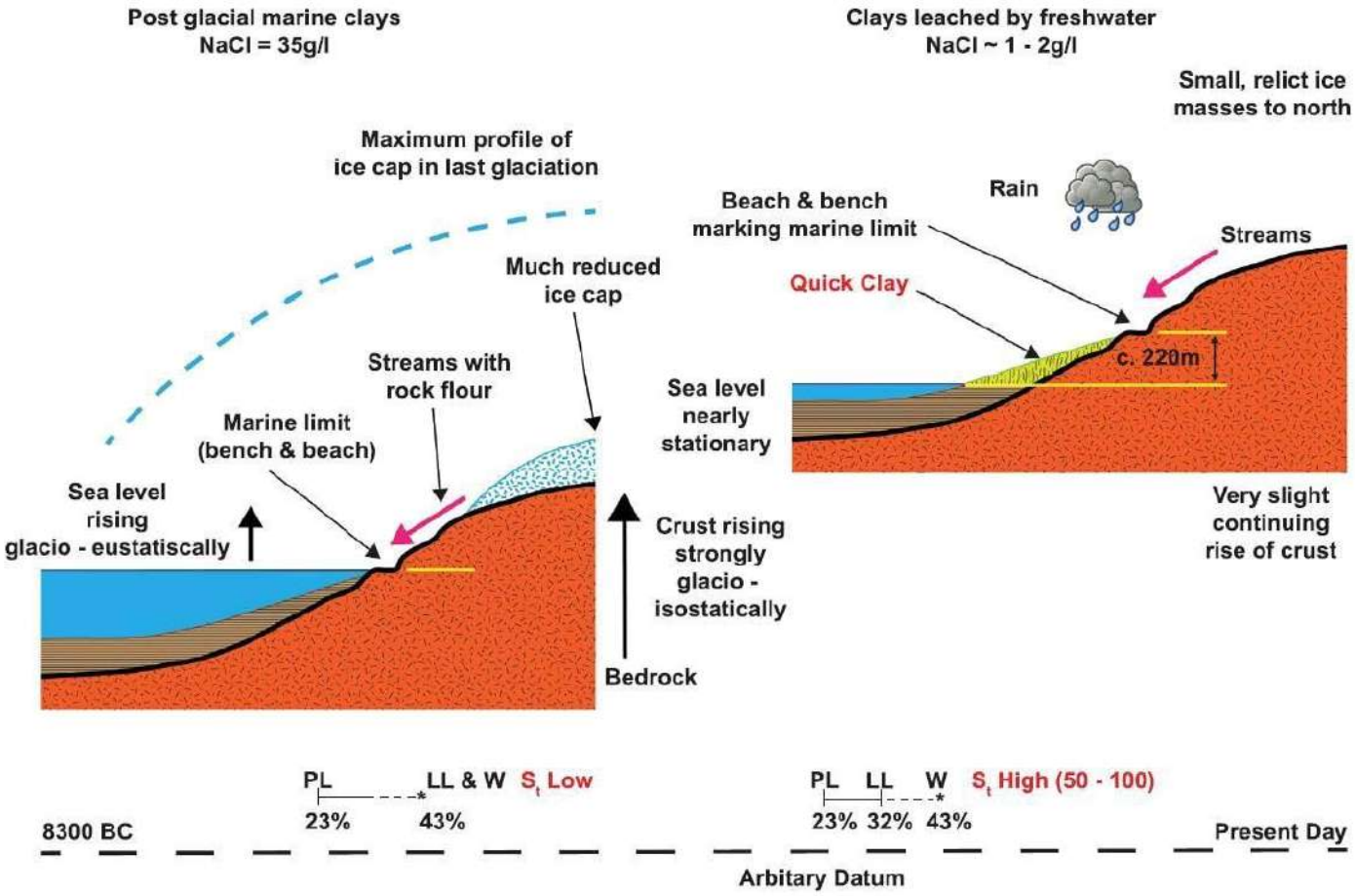
Five to six million cubic metres of clay collapsed from an area of 330,000 m2 leaving a 1.5 kilometre slide face. The landslide caused great material damage to the community of Leira when a resulting three-metre high floodwave breached the opposite bank of lake Botnen shortly after the main slide.

The Rissa landslide was caught on 8 mm cinefilm by two film amateurs. This is still used actively in avalanche preventative and educational work.

https://www.youtube.com/watch?time_continue=8&v=3q-qfNIEP4A&feature=emb_logo

(NGI - Norges Geotekniske Institutt)

Glacial Marine Clays



The aftermath of catastrophic Edenville Dam collapse, Michigan

About 10 000 people living in the towns of Edenville, Sanford, and Midland in central Michigan were forced to evacuate on May 19, 2020, after days of heavy rainfall caused catastrophic failure of Edenville and Sanford dams.

The National Weather Service (NWS) has issued flash flood emergencies along the entire Tittabawassee River in Midland County on May 20, with downstream effects expected from Midland to Saginaw. It was the second time in 24 hours that people were prompted to flee.

The river crested at record 10.68 m (35.05 feet) on the same day, breaking the previous record of 10.32 m (33.89 feet) set in 1986.

The devastating aftermath of the Edenville dam collapse was documented in these videos by Jordan Mowbray.

Jordan filmed the following video on May 21, two days after the collapse.

https://www.youtube.com/watch?v=YVLtOisocus&feature=emb_logo

(Teo Blašković / THE WATCHERS, June 9, 2020, https://watchers.news/2020/06/09/aftermath-damage-catastrophic-edenville-dam-collapse-michigan/)

On Camera, Three-Storey Building Falls Into Canal In West Bengal

A three-storey building under construction is seen falling into a canal, just metres away, in a video of the incident in a village in West Bengal's Midnapore district.

https://www.youtube.com/watch?v=kY0S-VDDZK0&feature=youtu.be&fbclid=IwAR1hGa-luzmFwi2eGyGNT4y1DFFEDSDpZ0qpEy30hIw690R68O_q3UASqr9Y

(NDTV, 13.06.2020)

Landslides in Japan increased nearly 50 percent in the past 10 years

An average of roughly 1 500 landslides took place in Japan ever year during the last 10 years, marking a surge of nearly 50 percent, according to a government report endorsed by the Cabinet of Japan.

Between 2000 and 2009, the average number of landslides per year was 1 006. It jumped by 1 476 every year or 46.7 percent between 2010 and 2019,

Rainfall amounts of about 50 mm (2 inches) per hour were registered 1.4 times more often than between 1976 and 1985.

The report also showed that in 2018, the country was struck by a record 3 459 landslides that were triggered by torrential rain in the western region and a significant earthquake in Hokkaido. Typhoon "Hagibis" and other torrential downpours also triggered 1 996 landslides.

Japan Ground Self-Defense Force at a landslide site in Chiba in October 2019.

This month, the Japanese government made legal actions to tighten restrictions on the development of red zone sites, where residents' lives are at the highest risk in the event of landslides, and to introduce a system for municipal governments to provide relocation.

The report added that Japan will seek to lessen flood damage by improving embankments, making underground water storage facilities, and promoting evacuation in major areas.

Meanwhile, the Japan Meteorological Agency (JMA) warned of landslides, particularly in the northern part of Kyushu hit by torrential rain this week.

Recently, a torrential downpour hit the southwestern prefecture of Nagasaki on June 25, which was described as a 'once-

in-50-year' event by JMA. Sasebo city also hit a record high for the month of June, with 281.5 mm (11 inches) registered in a 24-hour period.

During the same period, an M6.2 earthquake struck off eastern Japan, registering lower 5 on Japan's seismic intensity scale of 7, in Asahi, Chiba. There were no reports of landslides following the tremor, but JMA warned that quakes of the same intensity may follow over the next week in areas that experienced strong shaking.

The National Police Agency announced Thursday that it is preparing to launch a website in August, where citizens can share photos and videos of major calamities so authorities can promptly control traffic and begin relief operations.

(Julie Celestial / THE WATCHERS, June 27, 2020, https://watchers.news/2020/06/27/landslides-in-japan-increased-nearly-50-percent-in-the-past-10-years/)

Massive landslide sweeps away mountain road in eastern Indonesia

A huge landslide swept away a mountain road in eastern Indonesia on June 26, 2020.

One local captured the horrific collapse of the main road at Battang Barat, Wara Barat district, with several residents heard screaming in the background.

A building was swept away as the massive chunk of land slid down and completely buried the road.

The Trans Sulawesi Road, which connects Palopo and Tana Toraja, was cut off.

No casualties or injuries were reported.

Heavy rains have also been affecting Bolaang Mongondow Selatan in North Sulawesi, since June 27. About 220 houses were flooded, affecting 1,100 people.

https://www.youtube.com/watch?v=e4TL2MIcO_g&feature=emb_logo

(Julie Celestial / THE WATCHERS, June 29, 2020, https://watchers.news/2020/06/29/massive-landslide-sweeps-away-houses-in-a-mountain-road-in-eastern-indonesia/)

Landslide on the Rio Colca

Sometime between June 18 and June 19, 2020, a massive landslide occurred on the steep walls of the Cañon de Colca, completely blocking the Rio Colca. Within days, a lake had begun to fill the area behind the slide, damming the river. Construction workers arrived to mitigate the hazard, as the lake will continue to get bigger unless emergency crews dig a channel.

https://www.planet.com/gallery/#!/post/landslide-on-the-rio-colca

The 18 June 2020 Achoma landslide in Peru

On 18 June 2020 the very large Achoma Landslide occurred in valley of the Rio Colca in Peru. Many thanks to Gael Araujo of the Geological Service of Peru for highlighting this one to me, and to Robert Simmon of Planet Labs who independently identified it from satellite imagery. As far as I am aware, this landslide has not been reported in the English language media, but it is a very large, valley-blocking failure. La Republica has some drone imagery that gives a good impression of the scale of the landslide:

Drone imagery of the 18 June 2020 Achoma landslide in Peru.

As the image shows, the landslide has blocked the Rio Colca, allowing a lake to form. As of yesterday, the volume of the lake was about 2 million cubic metres. A state of emergency has been declared for the area, lasting 60 days, whilst efforts are being undertaken to drain the lake. The video below, collected by Ingemmet, should provide a good impression of the scale of this landslide:-

As noted above, Planet Labs has collected an excellent satellite image of this landslide:

This image clearly captures the scale of both the landslide (which covers an area of about 40 hectares) and the developing barrier lake.

(Dave Petley, 30 June 2020, https://blogs.agu.org/landslideblog/2020/06/30/achoma-landslide-1/)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Federal Investment in Seismology Matters

U.S. earthquake science protects Americans and the places they live and work. Sustained federal funding for seismology is key to that protection. There are no comparable private funders.

Safety and Security

Every $1 spent on earthquake mitigation efforts equals $10 saved in response and rebuilding costs.

The impacts of federally funded seismic science are geographically widespread, from supporting an earthquake and tsunami early warning program along the U.S. Pacific and Caribbean coasts to guiding economically important oil and gas operations in the central and eastern U.S.

Strong seismic science supports global nuclear test monitoring and informs national security strategy regarding both established nuclear states and potential nuclear proliferators.

Federal funding of earthquake science guides efforts to prepare for and rebuild after an earthquake, tsunami or volcanic eruption.

Federal agencies calculate possible economic losses from future earthquakes and provide essential data for insurance and reinsurance programs.

Seismologists, geophysicists and earthquake engineers are an agile workforce for diverse fields:

The estimated annualized earthquake loss to the national building stock is $6.1 billion.

- Energy Recovery and Management
- Space Exploration
- Geotechnical Assessment and Construction
- Water Monitoring and Management
- Public Safety and Natural Disaster Resilience
- Workforce and Innovation

Workforce and Innovation

Federally funded earthquake scientists were early promoters of the modem, feedback electronics, high performance computing, and machine learning—all technologies that have transformed the American economy. Continued investment will keep Americans competitive in the global tech sector.

Federal funds support colleges and universities that educate the next generation of earthquake scientists in all 50 states and territories and commonwealths, as well as university-run seismic networks that provide critical data for state and local infrastructure and economic development.

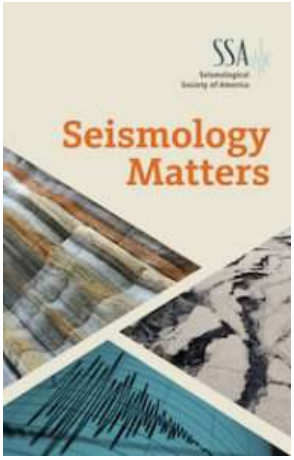
Federal Agencies and Products

Changes to earthquake science funding in one federal agency can have wide-ranging impacts across the science.

There are more than a dozen federal agencies that contribute valuable research, hazards monitoring and coordination with the larger community of earthquake scientists. The National Earthquake Hazards Reduction Program ensures that these coordinated efforts are strongly focused and fiscally responsible.

Products developed by federal agencies, including updates to the U.S. National Seismic Hazard Model and the Advanced National Seismic System, inform the country's planning around earthquakes through their impact on building codes, early warning and operational forecasting systems.

Request Copies of the Brochure



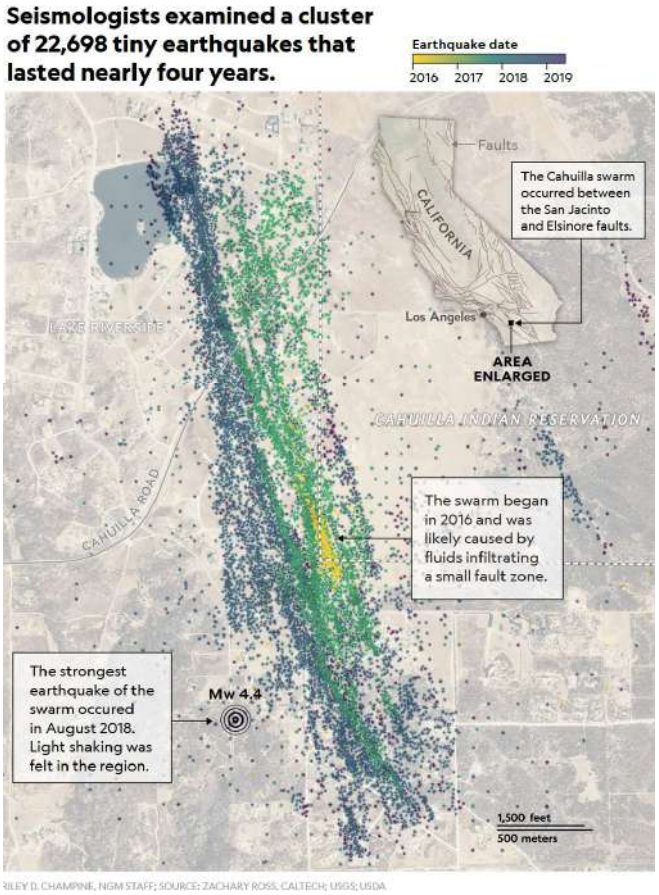
If you would like copies of the physical brochure, please write policy@seismosoc.org. We encourage members of the Society to share the message and help educate policymakers and members of the public.

(Seismological Society of America, https://www.seismosoc.org/us-government-relations/seismology-matters/)

A strange earthquake swarm lasted for years. Scientists finally know why.

A new high-resolution view into Earth's crust shows what caused more than 22,000 tiny temblors to rumble in Southern California.

Early in 2016, without any fanfare, a swarm of earthquakes silently revved up in Southern California. The quakes didn't occur every day, and most were too small for humans to feel, but month after month the tremors continued to rumble and multiply. By the spring of 2018, thousands of little quakes were striking each month, some large enough to set lamps swaying and put residents of nearby towns on edge. Over the past four years there have been more than 22,000 temblors. Yet the source behind all this activity has been a mystery.



RILEY D. CHAMPINE, NGM STAFF; SOURCE: ZACHARY ROSS, CALTECH; USGS; USDA

Now, in one of the highest resolution looks at a seismic swarm yet, scientists have zeroed in on a likely cause. The results may help geologists around the world better untangle the underlying physics of earthquakes both large and small. Eventually, similar work could even improve real-time earthquake monitoring.

The analysis used a computer algorithm to tease out the locations and timing of the tiny temblors, creating a stunningly detailed portrait of the swarm activity as it unfolded along a spidery network of fractures. This intimate picture of the swarm's progression suggests that the cluster of quakes was triggered by fluids being naturally injected into the fault system. The work hints that fluids may play a role in other swarms detected around the world—and the method used could prove useful for improving global seismic analysis.

"The detail here is incredible," says seismologist Elizabeth Vanacore from the Puerto Rico Seismic Network at the University of Puerto Rico at Mayagüez, who wasn't part of the study team. "This type of work is cutting edge and really where the science is going."

Spotting a swarm of tremors

Along a fault line, the fissures in Earth's crust were once imagined as simple structures, but "in reality, fault zones are very complicated places," says Emily Roland, a marine seismologist at the University of Washington who was not part of the study team. Some faults can bend. Others crisscross under the ground. The fractures analyzed in the new study weave together in a subterranean labyrinth sprawling across several miles.

The earthquake swarm that revealed this intricate structure passed unnoticed until 2017, when an email from a curious citizen landed in the mailbox of Southern California Seismic Network. That email requested information about a cluster of tiny quakes in a sparsely populated stretch of the state.

A cursory look at the region didn't reveal anything extraordinary, says Zachary Ross, a geophysicist at the California Institute of Technology who led the study, published June 18 in the journal *Science*. Located about 10 miles from the highly active San Jacinto fault zone, the area is often subject to tiny tremors. But by digging deeper into the region's seismic history, the researchers realized that the email's author was on to something: Starting nearly a year before, in 2016, a swarm of tiny earthquakes had rippled along the edge of the Cahuilla Band of Mission Indians reservation.

Such swarms of small quakes are distinct from large earthquakes, which often follow a familiar pattern: An intense event, or main shock, is followed by a series of aftershocks that taper off in magnitude and frequency over a predictable period of time.

Earthquake swarms are another geologic beast entirely. These events have little rhyme or reason to their progression, and they are sometimes made up of hundreds or thousands of small or moderate but similarly sized earthquakes. Most swarms occur as a burst of quakes over hours, days, or even months. In Puerto Rico, where swarms are particularly common, the bursts tend to last between 36 and 48 hours, Vanacore says.

While many swarms are associated with burbling volcanoes, others roll across landscapes far from any major activity. The potential for destruction from these events varies widely. The Cahuilla swarm pumped out quakes from early 2016 through last year—but all of the shakes were itty bitty, and they never generated significant damage in four years.

"How they start and why they do what they do is a matter of debate," says earthquake seismologist Abhijit Ghosh of the University of California, Riverside, who was not involved in the study.

To investigate these events in detail, scientists needed a way to spot all the tiny tremors in reams of seismic data. Over the

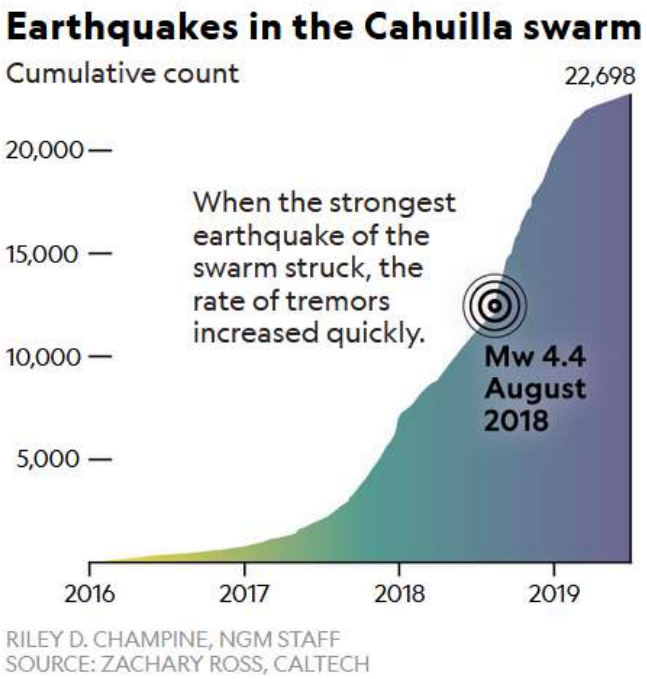
past several years, Ross and his colleagues have been working on new methods for detecting and monitoring earthquakes by harnessing the power of machine learning. By feeding earthquake data labeled by human experts into the algorithms of a neural network, the machine learned to recognize small earthquakes in the mess of squiggles from seismometers.

"We decided to turn this loose on [the Cahuilla swarm] dataset," Ross says.

The subterranean labyrinth

The result of the team's work is a remarkably complex look at how the Cahuilla swarm unfolded. The researchers conclude that a reservoir of fluid—such as water or liquid carbon dioxide—lingered beneath the fault structure. For many years, that fluid was sealed off from the fault system, but in 2016 something breached the rocky divide. Fluid was injected into the fault, altering the pressures of the system and lubricating the cracks, which triggered the swarm's first quakes some five miles deep.

Over the following months, the swarm slowly migrated upward and outward from this narrow starting point. A radiating front of quakes fanned out along underground fractures in the rock—precisely the way a fluid spreads. Some paths of the quake front eventually died out, perhaps as the fluids reached the end of a crack. Other times, the quakes seemed to pause at a boundary, migrating sideways before resuming their trajectory, like a river flowing around a rock.



In August 2018, nearly three years after the swarm began, one particularly stalwart blockage seemed to stall out the fluid's upward progression. The quakes took a turn before eventually finding a new path to resume their spread toward the surface. That's when the flow triggered the biggest earthquake measured in the swarm—a magnitude 4.4 event that anyone just above it would have felt rippling through the ground. The temblor was a "huge kick to the system," Ross says, triggering a spike of smaller quakes in one last burst of energy before the swarm died out.

In total, the study provides a convincing picture of fluids rushing into a fault zone and sending a four-year shudder through the rock beneath Southern California. Similar injections of fluid may cause many other swarms around the world, though there are likely multiple causes for clusters of quakes.

"Each swarm, each tectonic area, has its own quirks, its own identity," Vanacore says. Swarms in Puerto Rico, for example, rumble relatively deep beneath the surface and might be the result of a tear in a tectonic plate as it plunges underground.

The study also showcases how machine learning can help geologists paint a detailed picture of our planet's subterranean realms. Each earthquake is like a dot of a pointillist painting. By studying just the largest quakes, you see only a smattering of spots. But by filling in the tiny tremors, a complete portrait of the complex physics behind our planet's many creaks and quivers begins to emerge.

(Maya Wei-Haas / National Geographic, June 18, 2020, https://www.nationalgeographic.com/science/2020/06/strange-earthquake-swarm-lasted-years-scientists-finally-know-wh)

Underground fluid injections triggered earthquake swarm near Cahuilla, California

A new seismological study found that a naturally-occurring injection of underground fluids triggered an earthquake swarm near Cahuilla, California, that lasted for nearly four years. The research shows an evolving understanding of how fault architecture drives earthquake patterns.

"We used to think of faults more in terms of two dimensions: like giant cracks extending into the earth," said lead author Zachary Ross, also an assistant professor of geophysics.

"What we're learning is that you really need to understand the fault in three dimensions to get a clear picture of why earthquake swarms occur."

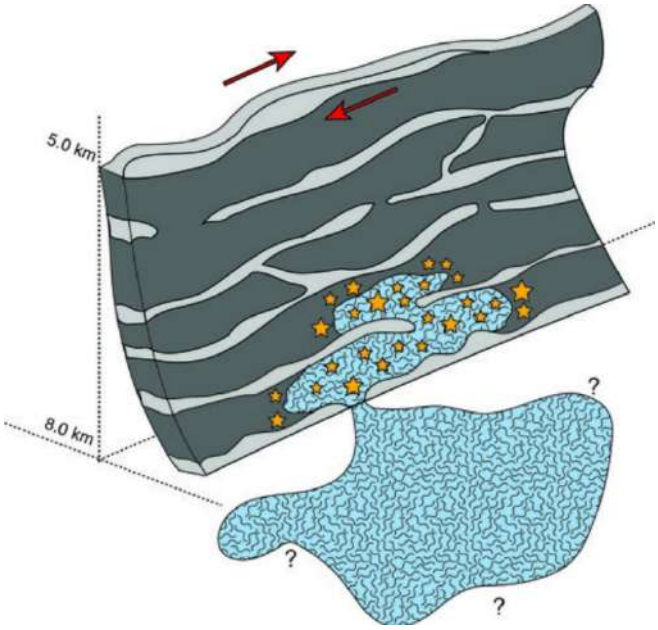
Known as the Cahuilla swarm, it is a sequence of small tremors that happened between 2016 and 2019 near Mt. San Jacinto in Southern California.

Ross, along with his colleagues from Caltech, USGS, and the University of Texas used earthquake-detection algorithms with deep neural networks to generate a highly-detailed catalog of over 22 000 seismic events in the area, with magnitudes ranging from 0.7 to 4.4.

The compilation unveiled a complex but narrow fault zone, just 50 m (164 feet) wide, with steep curves. Ross said plotting those curves was crucial to understanding why the seismic activity lasted for years.

Faults are typically believed to either act as conduits for or barriers to the flow of underground fluids. While Ross's study generally supports that, the team discovered that the architecture of the fault produced complex conditions for underground fluids.

The team noted that the fault zone had undulating subterranean channels that linked with an underground reservoir of fluid, which was initially sealed off from the fault.



When the seal broke, fluids were injected into the fault zone and dispersed through the channels, prompting earthquakes. The team found that this natural injection process was sustained over around four years.

"These observations bring us closer to providing concrete explanations for how and why earthquake swarms start, grow, and terminate," said Ross.

The team's next plan is to build off these new insights and determine the role of this type of process throughout entire Southern California.

Reference

"3D fault architecture controls the dynamism of earthquake swarms" - Ross, Z. E. et al. - Science - DOI: 10.1126/science.abb0779

Abstract

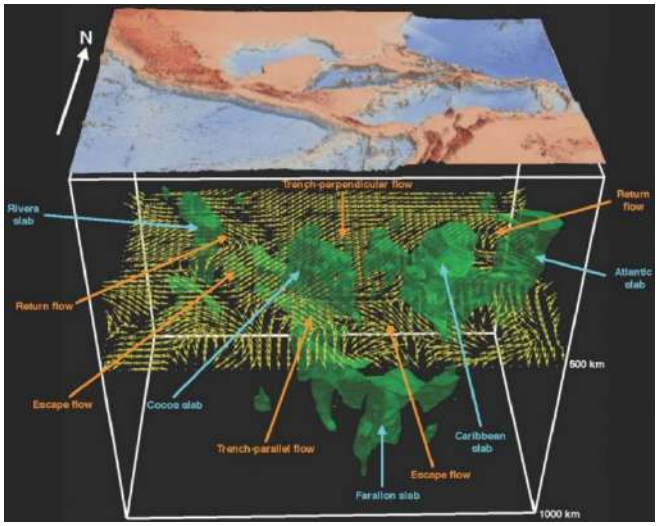
The vibrant evolutionary patterns made by earthquake swarms are incompatible with standard, effectively two-dimensional (2D) models for general fault architecture. We leverage advances in earthquake monitoring with a deep-learning algorithm to image a fault zone hosting a 4-year-long swarm in southern California. We infer that fluids are naturally injected into the fault zone from below and diffuse through strike-parallel channels while triggering earthquakes. A permeability barrier initially limits up-dip swarm migration but ultimately is circumvented. This enables fluid migration within a shallower section of the fault with fundamentally different mechanical properties. Our observations provide high-resolution constraints on the processes by which swarms initiate, grow, and arrest. These findings illustrate how swarm evolution is strongly controlled by 3D variations in fault architecture.

(Julie Celestial / THE WATCHERS, June 21, 2020, https://watchers.news/2020/06/21/underground-fluid-injections-triggered-earthquake-swarm-near-cahuilla-california/)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

Scientists create 3D images of geological processes below Earth's surface

Geoscientists at the University of Texas at Dallas generated high-resolution, 3D images of the dynamic geological processes that are happening far below the Earth's surface. The team described in the study how they created images of mantle flows in a subduction zone under Central America and the Caribbean Sea using a full waveform inversion (FWI)-- a computationally intensive technique.



"This is the first comprehensive seismic study to directly image 3D mantle flow fields in actual subduction environments using advanced FWI technology," said co-author Dr. Hejun Zhu, also an assistant professor of geosciences in the School of Natural Sciences and Mathematics.

Earth's crust is broken into tectonic plates that move across and into the mantle very slowly. One plate descends under another into the mantle at regions called subduction zones.

"The sinking of oceanic plates into the Earth's mantle at subduction zones is what causes the Earth's tectonic plates to move and is one of the most important processes taking place in our planet," Zhu explained.

"Subduction zones are also the source of many natural hazards, such as earthquakes, volcanoes, and tsunamis. But the pattern of mantle flow and deformation around descending plates is still poorly understood. The information our techniques yield is crucial for understanding our dynamic planet."

The researchers addressed the problem by using seismic anisotropy, which measures the difference in how fast mechanical waves produced by tremors travel in different directions inside the Earth.

"When a diver dives into the water, the water separates, and that separation, in turn, affects the way the water moves around the swimmer," said Zhu.

"It's similar to oceanic plates: When they dive into the hot mantle, that action induces mantle separation and flow around the plates."

The team generated the images using high-fidelity data recorded over a 10-year period, from 180 quakes by around 4 500 seismic stations in a grid across the U.S.

The numerical calculations for the FWI algorithm were done on the high-performance computing clusters at the National Science Foundation (NSF) supported Texas Advanced Computing Center at UT Austin, as well as on supercomputers at UT Dallas.

"Previously we couldn't 'see' under the Earth's surface, but by using this technology and this very wonderful data set, we are able to delineate the 3D distribution of various seismic phenomena and tell at what depths they are occurring," Zhu stated.

The images confirmed that the plates in the region are not huge, solid pieces, but are fragmented into smaller slabs.

"This looks different from the textbook depictions of tectonic plates coming together, with one solid piece of oceanic plate descending under another solid piece," Zhu indicated.

"Some researchers have hypothesized that this fragmentation occurs, and our imaging and modeling provides evidence that supports that view."

Zhu's 3D model shows complex mantle flow patterns around descending fragments and in the gaps between slabs. For instance, the Juan de Fuca Plate in the northwestern U.S. is also fragmented into two pieces where it goes under the North American Plate in the Cascadia subduction zone.

"We know that most earthquakes happen at the interface between a slab and the mantle. If there is a gap between these fragments, what's called a window region, you wouldn't expect earthquakes there," Zhu further explained.

"If you look at the earthquake distribution along the Cascadia subduction zone, there is a span where you do not have earthquakes. That is probably a region where there is a gap in the subducting oceanic plate."

"The Middle America Trench that we studied has its own unique, dynamic properties. In the future, we plan to shift our attention to other subduction zones, including the Kermadec-Tonga subduction zone in the region of the Australian and Pacific plates."

Reference

"Seismic evidence for subduction-induced mantle flows underneath Middle America" - Zhu, H. et al. - Nature Communications - https://doi.org/10.1038/s41467-020-15492-6

Abstract

Laboratory experiments and geodynamic simulations demonstrate that poloidal- and toroidal-mode mantle flows develop around subduction zones. Here, we use a new 3-D azimuthal anisotropy model constructed by full-waveform inversion, to infer deep subduction-induced mantle flows underneath Middle America. At depths shallower than 150 km (93 miles), poloidal-mode flow is perpendicular to the trajectory of the Middle American Trench. From 300 to 450 km (186 to 280 miles) depth, return flows surround the edges of the Rivera and Atlantic slabs, while escape flows are inferred through slab windows beneath Panama and central Mexico. Furthermore, at 700 km (435 miles) depth, the study region is dominated by the Farallon anomaly, with fast axes perpendicular to its strike, suggesting the development of lattice-preferred

orientations by substantial stress. These observations provide depth-dependent seismic anisotropy for future mantle flow simulations and call for further investigations about the deformation mechanisms and elasticity of minerals in the transition zone and uppermost lower mantle.

(Julie Celestial / THE WATCHERS, June 21, 2020, https://watchers.news/2020/06/21/scientists-create-3d-images-geological-processes-below-earth-surface)

Μια τεράστια ηφαιστειακή έκρηξη στην Αλάσκα επέφερε πιθανώς το τέλος της Ρωμαϊκής Δημοκρατίας

Μια μεγάλη διεθνής ομάδα επιστημόνων και ιστορικών από την Ευρώπη και τις ΗΠΑ ανακοίνωσε ότι βρήκε βάσιμες ενδείξεις για την προέλευση μιας έως τώρα ανεξήγητης εξαιρετικά κρύας περιόδου στην αρχαία Ρώμη και τις γειτονικές περιοχές, συμπεριλαμβανομένης της Ελλάδας

Μια μεγάλη διεθνής ομάδα επιστημόνων και ιστορικών από την Ευρώπη και τις ΗΠΑ ανακοίνωσε ότι βρήκε βάσιμες ενδείξεις για την προέλευση μιας έως τώρα ανεξήγητης εξαιρετικά κρύας περιόδου στην αρχαία Ρώμη και τις γειτονικές περιοχές, συμπεριλαμβανομένης της Ελλάδας.

Αιτία του φαινομένου αυτού θεωρείται πως ήταν η τεράστια έκρηξη του ηφαιστείου Οκμόκ στις Αλεούτιες νήσους της Αλάσκας, στην άλλη άκρη της Γης, η οποία είχε ως συνέπεια να σκοτεινιάσει, λόγω τέφρας, ο ουρανός του πλανήτη και να πέσει απότομα η θερμοκρασία.

Αρχαίες γραπτές πηγές αναφέρουν ότι την εποχή περίπου της δολοφονίας του Ιουλίου Καίσαρα, το 44 π.Χ., ο Ήλιος είχε εξαφανιστεί από τον ουρανό και υπήρξε στη Ρώμη μια περίοδος ασυνήθιστα κρύου κλίματος, που συνοδεύτηκε από την καταστροφή γεωργικών καλλιεργειών, πείνα (υπάρχουν αναφορές και για την Ελλάδα), αρρώστιες, καθώς επίσης κοινωνική και πολιτική αναταραχή στην ευρύτερη περιοχή της Μεσογείου.

Ένας συνδυασμός παραγόντων, που εξασθένησε τη δημοκρατία στη Ρώμη και άνοιξε το δρόμο στην αυτοκρατορία, ενώ ανάλογη αρνητική επίδραση πιστεύεται ότι υπήρξε και στο πτολεμαϊκό βασίλειο της Αιγύπτου.

Υπήρχαν εδώ και καιρό υποψίες ότι κάποια ηφαιστειακή έκρηξη μπορεί να είχε «βάλει το χεράκι» της, αλλά έως τώρα δεν είχε βρεθεί κάποιο συγκεκριμένο ηφαίστειο που να ενοχοποιείται.

Τώρα, οι ερευνητές, με επικεφαλής το δρα Τζόε ΜακΚόνελ του Ερευνητικού Ινστιτούτου της Ερήμου στη Νεβάδα, οι οποίοι έκαναν τη σχετική δημοσίευση στο περιοδικό της Εθνικής Ακαδημίας Επιστημών των ΗΠΑ (PNAS), ανέλυσαν ηφαιστειακή τέφρα που βρέθηκε σε αρκτικούς πυρήνες πάγου στη Γροιλανδία και στη Ρωσία.

Από τη γεωχημική ανάλυση αποκαλύπτεται μια αρχική ηφαιστειακή έκρηξη το 45 π.Χ. και μια δεύτερη ισχυρότερη το 43 π.Χ., η οποία άφησε ίχνη τέφρας επί περίπου δύο χρόνια.

Χάρη στην πολύ βόρεια τοποθεσία του ηφαιστείου, τα σωματίδια της τέφρας μπορούσαν εύκολα να φθάσουν στη στρατόσφαιρα και να εξαπλωθούν σε όλο το βόρειο ημισφαίριο.

Οι ερευνητές πιστεύουν ότι πλέον είναι σε θέση να συσχετίσουν το κρύο κλίμα της Ανατολικής Μεσογείου πριν από 2.000 χρόνια με την έκρηξη του Οκμόκ το 43 π.Χ.

Ήταν μια από τις πιο ισχυρές εκρήξεις στον κόσμο τα τελευταία 2.500 χρόνια, η οποία οδήγησε στη δημιουργία μιας μεγάλης καλδέρας διαμέτρου δέκα χιλιομέτρων στα νησιά της Αλάσκας.

«Το να βρούμε στοιχεία ότι ένα ηφαίστειο στην άλλη πλευρά της Γης εξερράγη και ουσιαστικά συνέβαλε στην πτώση των Ρωμαίων και των Αιγυπτίων είναι συναρπαστικό. Δείχνει σίγουρα πόσο διασυνδεδεμένος ήταν ο κόσμος ακόμη και πριν από 2.000 χρόνια» δήλωσε ο ΜακΚόνελ.

«Το τέλος της Ρωμαϊκής Δημοκρατίας έλαβε χώρα κατά τη διάρκεια αυτών των δύο ετών ακραίου κλίματος. Θα μπορούσε να είναι σύμπτωση, αλλά δε φαίνεται πιθανό» πρόσθεσε.

Τα δύο χρόνια που ακολούθησαν την έκρηξη του 43 π.Χ. ήταν από τα πιο κρύα στο βόρειο ημισφαίριο τα τελευταία 2.500 χρόνια, ενώ η επόμενη δεκαετία εκτιμάται ότι ήταν η τέταρτη πιο κρύα.

Τα κλιματικά μοντέλα εκτιμούν ότι στις θερινές και στις φθινοπωρινές περιόδους που ακολούθησαν την έκρηξη οι μέσες θερμοκρασίες στη Νότια Ευρώπη και στη Βόρεια Αφρική ήταν έως επτά βαθμούς Κελσίου χαμηλότερες από τις κανονικές για την εποχή.

Παράλληλα, οι βροχές στη Νοτιοανατολική Ευρώπη το καλοκαίρι ήταν 50% έως 120% μεγαλύτερες από τις συνηθισμένες, ενώ το φθινόπωρο ήταν αυξημένες έως 400%.

«Στη Μεσόγειο αυτές οι υγρές και ακραία κρύες συνθήκες πιθανώς μείωσαν τις γεωργικές αποδόσεις και επιδείνωσαν τα προβλήματα τροφοδοσίας κατά τη διάρκεια των συνεχιζόμενων πολιτικών αναταραχών της περιόδου» δήλωσε ο αρχαιολόγος Άντριου Ουίλσον του Πανεπιστημίου της Οξφόρδης.

«Ιδιαίτερα σοβαρή ήταν η καταστροφή λόγω της πλημμύρας του Νείλου την εποχή της έκρηξης του Οκμόκ, μια περίοδος λιμού και αρρώστιας, που αναφέρεται στις αιγυπτιακές πηγές. Οι κλιματικές επιπτώσεις αποτέλεσαν ένα σοβαρό σοκ σε μια ήδη στρεσαρισμένη κοινωνία σε μια κομβική στιγμή της ιστορίας της» ανέφερε ο ιστορικός Τζόε Μάνινγκ του Πανεπιστημίου Γέηλ.

Άλλοι πάντως επιστήμονες, σύμφωνα με το Science, εμφανίζουν μεγαλύτερο σκεπτικισμό, θεωρώντας ότι η δημοκρατία στη Ρώμη βρισκόταν ήδη σε φάση αποδρομής αρκετόν καιρό πριν από την προαναφερθείσα ηφαιστειακή έκρηξη.

Ο θάνατος του Κικέρωνα το 42 π.Χ. θεωρείται το συμβολικό τέλος της Ρωμαϊκής Δημοκρατίας.

(Πηγή πληροφοριών: ΑΠΕ – ΜΠΕ)

(in.gr, 23 Ιουνίου 2020,

https://www.in.gr/2020/06/23/tech/mia-terastia-ifaisteiaki-ekriksi-stin-alaska-epefere-pithanos-telos-tis-romaikis-dimokratias/)

Extreme climate after massive eruption of Alaska's Okmok volcano in 43 BCE and effects on the late Roman Republic and Ptolemaic Kingdom

Joseph R. McConnell, Michael Sigl, Gill Plunkett, Andrea Burke, Woon Mi Kim, Christoph C. Raible, Andrew I. Wilson, Joseph G. Manning, Francis Ludlow, Nathan J. Chellman, Helen M. Innes, Zhen Yang, Jessica F. Larsen, Janet R. Schaefer, Sepp Kipfstuhl, Seyedhamidreza Mojtabavi, Frank Wilhelms, Thomas Opel, Hanno Meyer, and Jørgen Peder Steffensen

Significance

The first century BCE fall of the Roman Republic and Ptolemaic Kingdom and subsequent rise of the Roman Empire were among the most important political transitions in the history of Western civilization. Volcanic fallout in well-dated Arctic ice core records, climate proxies, and Earth system modeling show that this transition occurred during an extreme cold period resulting from a massive eruption of Alaska's Okmok volcano early in 43 BCE. Written sources describe unusual climate, crop failures, famine, disease, and unrest in the Mediterranean immediately following the eruption—suggesting significant vulnerability to hydroclimatic shocks in otherwise sophisticated and powerful ancient states. Such shocks must be seen as having played a role in the historical developments for which the period is famed.

Abstract

The assassination of Julius Caesar in 44 BCE triggered a power struggle that ultimately ended the Roman Republic and, eventually, the Ptolemaic Kingdom, leading to the rise of the Roman Empire. Climate proxies and written documents indicate that this struggle occurred during a period of unusually inclement weather, famine, and disease in the Mediterranean region; historians have previously speculated that a large volcanic eruption of unknown origin was the most likely cause. Here we show using well-dated volcanic fallout records in six Arctic ice cores that one of the largest volcanic eruptions of the past 2,500 y occurred in early 43 BCE, with distinct geochemistry of tephra deposited during the event identifying the Okmok volcano in Alaska as the source. Climate proxy records show that 43 and 42 BCE were among the coldest years of recent millennia in the Northern Hemisphere at the start of one of the coldest decades. Earth system modeling suggests that radiative forcing from this massive, high-latitude eruption led to pronounced changes in hydroclimate, including seasonal temperatures in specific Mediterranean regions as much as 7 °C below normal during the 2 y period following the eruption and unusually wet conditions. While it is difficult to establish direct causal linkages to thinly documented historical events, the wet and very cold conditions from this massive eruption on the opposite side of Earth probably resulted in crop failures, famine, and disease, exacerbating social unrest and contributing to political realignments throughout the Mediterranean region at this critical juncture of Western civilization.

(Proceedings of the National Academy of Sciences of the United States of America (PNAS), June 22, 2020, https://www.pnas.org/content/early/2020/06/17/2002722117)

Some Arctic ground no longer freezing—even in winter

Data from two Arctic sites suggest some surface layers are no longer freezing. If that continues, greenhouse gases from permafrost could accelerate climate change.

CHERSKIY, RUSSIA - Nikita Zimov was teaching students to do ecological fieldwork in northern Siberia when he stumbled on a disturbing clue that the frozen land might be thawing far faster than expected.

Ground collapses at Duvanny Yar, a permafrost megaslump along the Kolyma River in northern Siberia. New research suggests that some land in Arctic Alaska and Russia may no longer freeze at all. This constantly moving landslide, driven by erosion and sped up by warming temperatures, is an important research site for scientists, who use it to track what happens as carbon-rich land that has been frozen for centuries begins to thaw.

Sergey Zimov measures permafrost levels with his granddaughters near the Northeast Science Station which he founded in Cherskiy, Russia, along the Kolyma River. About an hour away is Zimov's large-scale scientific experiment Pleistocene Park, which he runs with his son, Nikita Zimov. The two believe that by recreating the ecosystem of the Pleistocene era, which was dominated by grasslands and large mammals, they can slow permafrost thaw.c

Zimov, like his father, Sergey Zimov, has spent years running a research station that tracks climate change in the rapidly

warming Russian Far East. So when students probed the ground and took soil samples amid the mossy hummocks and larch forests near his home, 200 miles north of the Arctic Circle, Nikita Zimov suspected something wasn't right.

In April he sent a team of workers out with heavy drills to be sure. They bored into the soil a few feet down and found thick, slushy mud. Zimov said that was impossible. Cherskiy, his community of 3,000 along the Kolyma River, is one of the coldest spots on Earth. Even in late spring, ground below the surface should be frozen solid.

Except this year, it wasn't.

Every winter across the Arctic, the top few inches or feet of soil and rich plant matter freezes up before thawing again in summer. Beneath this active layer of ground extending hundreds of feet deeper sits continuously frozen earth called permafrost, which, in places, has stayed frozen for millennia.

But in a region where temperatures can dip to 40 degrees below zero Fahrenheit, the Zimovs say unusually high snowfall this year worked like a blanket, trapping excess heat in the ground. They found sections 30 inches deep—soils that typically freeze before Christmas—that had stayed damp and mushy all winter. For the first time in memory, ground that insulates deep Arctic permafrost simply did not freeze in winter.

Polygons formed by the annual freezing and thawing of ice wedges just below the earth's surface are visible from above near the Northeast Science Station in Cherskiy, Russia.

"This really is astounding," says Max Holmes, an Arctic scientist with Woods Hole Research Center in Massachusetts.

The discovery has not been peer-reviewed or published and represents limited data from one spot in one year. But with measurements from another scientist nearby and one an ocean away appearing to support the Zimovs' findings, some Arctic experts are weighing a troubling question: Could a thaw of permafrost begin decades sooner than many people expect in some of the Arctic's coldest, most carbon-rich regions, releasing trapped greenhouse gases that could accelerate human-caused climate change?

Already, three of the last four years have been earth's hottest on record, with 2018 on schedule to be number four. And the poles are actually warming far faster, with areas 300 miles north of the Arctic Circle in Norway reaching 90 degrees Fahrenheit this July. If significant quantities of permafrost start thawing early, that would only make things worse.

"This is a big deal," says Ted Schuur, a permafrost expert at Northern Arizona University. "In the permafrost world, this is a significant milestone in a disturbing trend—like carbon in the atmosphere reaching 400 parts per million."

Nikita Zimov creates methane bubbles in a lake believed to be expanding due to thawing ground.

Foxtail, fireweed and cotton flowers are ubiquitous in Cherskiy, Russia, during the summer. The town is built entirely on permafrost. Buildings are constructed on concrete stilts with their pipes above ground to account for changes in the topography as permafrost thaws.

Crossing a Threshold

Nearly a quarter of the Northern Hemisphere's landmass sits

above permafrost. Trapped in this frozen soil and vegetation is more than twice the carbon found in the atmosphere.

As fossil-fuel burning warms the Earth, this ground is thawing, allowing microbes to consume buried organic matter and release carbon dioxide and shorter-lived methane, which is 25 times as potent a greenhouse gas as CO_2.

Permafrost temperatures across the Arctic have been rising since at least the 1970s—so much that small-scale localized thawing is already underway in many places. But the vast majority of this frozen land is still insulated by an active layer of freezing and thawing ground above it.

Now signs are emerging that the annual freeze-up can quickly change.

Eleven miles downriver from where the Zimovs' started their drilling, Mathias Goeckede with Germany's Max Planck Institute for Biogeochemistry spends weeks each summer traversing crumbling boardwalks over spongy Siberian ground. He tracks carbon exchange between the earth and the atmosphere.

Tundra grass show melting moisture near where the Kolyma River meets the Arctic Ocean.

Measurements at his site show that snow depth there has roughly doubled in five years. When excessive snow smothers the ground, warmth below the surface may not dissipate during winter. Data from a drill hole on Goeckede's site appears to capture that phenomenon: In April, temperatures 13 inches below ground there increased roughly 10 degrees Fahrenheit in that same five-year period.

"This is just one site, and it's just five years, so this really should be considered just a case-study," Goeckede says. "But if you assume it's a trend or that it might continue like this, then it's alarming."

Thousands of miles away, Vladimir Romanovsky saw something similar. Romanovsky, a permafrost expert at the University of Alaska, Fairbanks, runs some of the most extensive permafrost monitoring sites in North America, with detailed records going back 25 years, and in some cases longer.

"For all years before 2014, the complete freeze-up of the active layer would happen in mid-January," he says. "Since 2014, the freeze-up date has shifted to late February and even March."

But this winter, Fairbanks, too, saw extremely heavy snow. And for the first time on record, the active layer at two of Romanovsky's sites didn't freeze at all.

"This is really a very important threshold," he adds.

The Batagaika Crater in the town of Batagay, Russia, is known as the "hell crater" or the "gateway to the underworld." Over 300 feet deep and more than half a mile long, the depression is one of the largest in the world. Scientists believe it started forming in the 1960s when the permafrost under the area began to thaw after nearby forests were cleared.

Permafrost can be seen up close along the perimeter of the Batagaika Crater.

Reasons to Be Skeptical

Of course, Arctic weather is famously variable. A few years of heavy snow in some regions could give way quickly to a long stretch of dry cold years.

Some scientists are also torn about work by the Zimovs, which isn't as rigorous as many western researchers are accustomed to. The Zimovs' findings didn't include temperature data, nor could they point to long-term records. Many of the sites they examined also had been disturbed by human activity or non-native animals, which makes soil more susceptible to warming.

"Digging holes in a handful of places is hardly rigorous science," says Matt Sturm, a snow expert at the University of Alaska, Fairbanks.

Charles Koven, a permafrost expert at Lawrence Berkeley National Laboratory, sees cause for skepticism and more research. "I don't know what to think without knowing more about the history of these sites," he says. "On the other hand, we don't want to ignore warning signs if they're there."

What's more, compared to Romanovsky and Goeckede, who are measured and methodical researchers, Sergey Zimov is something of a catastrophist-philosopher, who leans toward pessimistic projections and grand gestures. He and his son

are the pair behind Pleistocene Park, a region in their stretch of Siberia roamed by imported large mammals, from bison to yaks and horses. It is part of an experiment to mimic the mammoth steppe ecosystem that ended 12,000 years ago to see how permafrost responds.

Scientist Sergey Zimov stares out over the Arctic Ocean at a research station 70 miles north of his home in Cherskiy, Russia. Zimov uses the metal rod in his hand to quickly test the depth of frozen ground.

At the same time, Sergey Zimov was also one of the first scientists anywhere to show that Siberia contains enormous reserves of especially carbon-rich permafrost. And he has worked in Cherskiy for more than 40 years and is held in high regard by many researchers.

"He knows that landscape so well that he is very rarely wrong," says Katey Walter Anthony, an associate professor at the University of Alaska, Fairbanks, who studies methane in Arctic lakes. "For him to believe a process is important is valuable."

Romanovsky knows the Zimovs, too, and says that while he wishes their work included temperature data, checking freeze depth is a sound approach. "That's still a convincing method," Romanovsky says. "For me, it just means it's not 100 percent."

It's also not clear how widespread a region Romanovsky's and the Zimovs' findings represent. It is a small sample size.

But Romanovsky says his sites were chosen because they fairly represent central Alaska.

Frost lines the walls of an ice cellar in Cherskiy, Russia. Residents have dug ice cellars, or freezers, into the permafrost for thousands of years. Recently, some people have observed cellars flooding due to permafrost thaw.

"So, we assume that freeze-up didn't happen this winter within large areas in the Alaskan Interior," he says.

And even scientists uncomfortable with the limited data say the possibility that something so fundamental could change so quickly gives them pause.

"It's worrisome," says Sue Natali, a permafrost expert, also with Woods Hole, who saw an active layer not re-freeze recently during a research trip to Alaska's Yukon region. "When we see things happening that haven't happened in the lifetime of the scientists studying them, that should be a concern."

Most permafrost remains frozen. But some, in northern parts of Siberia and several other sites in the Arctic, is at risk of thawing far faster than expected, threatening to release large quantities of carbon dioxide and methane.

An Accelerating Cycle

The stakes are high. If a region's active layer stops freezing consistently, consequences can be swift. Once unfrozen, soil microbes in the active layer can decompose organic material and release greenhouse gases year-round—not just in summer. And it exposes permafrost below to more heat so that layer, too, can begin thawing and releasing gases.

In ice-rich soils, such as in Siberia, the ground may slump. That can buckle roads and buildings and cause ice cellars to collapse. Such depressions also alter the landscape by forming troughs and bowls where snow can accumulate, making the ground even warmer in winter. Those troughs can fill with rain and snowmelt, forming new wetlands and tundra lakes, both of which expel large amounts of methane.

And the movement of all this water, above and below ground, can transport large amounts of heat, hastening thawing. Permafrost collapse can begin feeding on itself, releasing more greenhouse gases, which fuel more warming.

No one expects permafrost will ever release all its stored carbon. Most models suggest just 10 to 20 percent at most would escape even at high human emissions scenarios.

But more than a dozen Arctic climate scientists contacted by *National Geographic* agree that this year's active-layer data highlights the limitations of global climate models. The sophisticated computer programs that forecast future climate scenarios often used by government decision-makers simply can't capture major changes in permafrost.

"When we simulate these things there are a number of processes the models don't include—processes that multiply the transfer of heat," says Daniel Fortier, an associate professor of geography with the University of Montreal. "I think it's safe

to say that things are happening faster than we were expecting."

The Batagaika Crater is one of the few places to see a wall of permafrost—and whether it's thawing—up close. Scientists study the area for clues about climate change in the Arctic and how it may affect the rest of the planet.

For example, scientists have long known that loss of sea ice and rising temperatures will lead to more Arctic snow over time, which models are able to incorporate. But those same simulations are far less reliable when trying to track the cascading shifts in soil types, surface vegetation, melting ice, and the flow of water that will come from rising temperatures and all that snow, all of which could substantially hasten permafrost thaw.

"The models can't handle those landscape-scale changes, all of the processes that could lead to rapid change," says David Lawrence, a permafrost modeler with the National Center for Atmospheric Research in Boulder. "And it's going to be a long time before they can."

By the time some changes are detected, a significant transition may be underway, he says. That means the public and policymakers may not grasp the real risks.

"Most models don't project major carbon releases until beyond 2100," Walter Anthony says. That may be the case. But it's also possible, she says, that they "could actually happen in my children's lifetime—or my own."

(Craig Welch / National Geographic, August 20, 2018, https://www.nationalgeographic.com/environment/2018/08/news-arctic-permafrost-may-thaw-faster-than-expected)

Γεωλογικά θαύματα της Ελλάδας: Βλυχάδα Σαντορίνης

Μπροστά στους Ηφαιστειακούς γίγαντες της Βλυχάδας οτιδήποτε φαντάζει ανύπαρκτο

Σαν να την σμίλεψε ένας "υπερφυσικός" Gaudi, ένα θείο δώρο της ηφαιστειακής δράσης, η Βλυχάδα δεν είναι απλώς η ωραιότερη παραλία της Σαντορίνης αλλά ένα από τα πιο σαγηνευτικά γεωλογικά μνημεία ολόκληρης της Ευρώπης. Τα σμιλεύματα της αρχαίας τέφρας αλλάζουν κάθε εποχή και κάθε χρόνο και όποτε την ξαναβλέπεις παρατηρείς κάτι καινούργιο. Δυστυχώς το απείρου κάλλους μνημείο απειλείται τα τελευταία χρόνια από την οικοδομική δραστηριότητα.

Ωραία η Σαντορίνη... Δεν πήρε τυχαία το όνομα Καλλίστη από τους Αργοναύτες!!!..

(Αθηνολόγιο, 15 Ιουνίου 2020, https://www.facebook.com/athenologio/photos/a.108845093995472/175387857341195/?type=3&theater)

Φραγκοκέφαλα

Η Λήμνος ξεχωρίζει για τις υπέροχες παράλιες την ιδιαίτερη αρχιτεκτονική και τα γραφικά χωριά ,που αποτελούν πόλο έλξης για τους επισκέπτες.

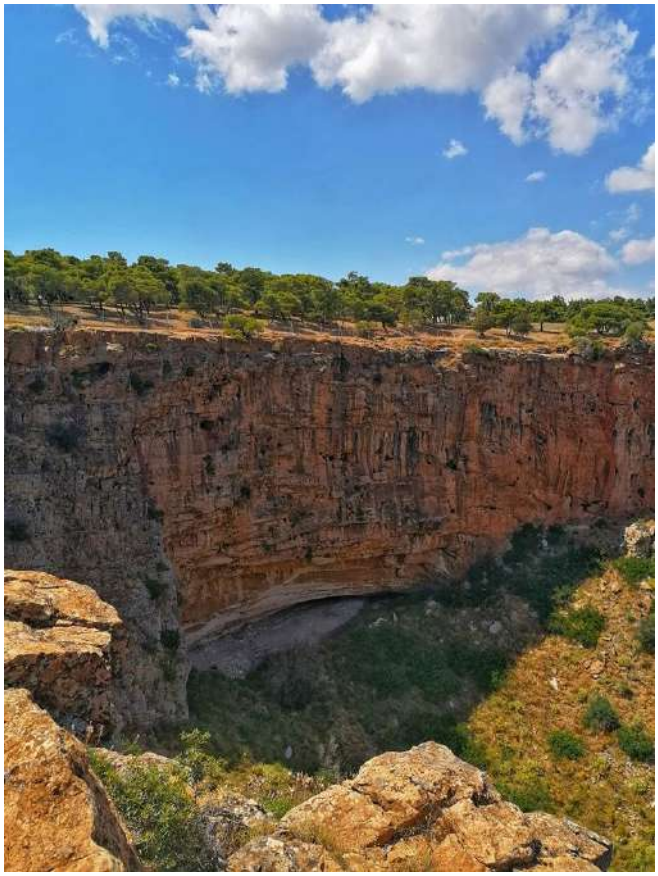
Μέσα σε τόσες ομορφιές υπάρχουν κάποιες τοποθεσίες σε αυτά θυμίζουν εξωγήινα τοπία. Στα βόρεια του νησιού μετά το χωριό Προπούλι στο Φαλακρό η Φαρακλό, όπως το λένε οι ντόπιοι, εάν πανέμορφο γεωλογικό φαινόμενο προσφέρει ξεχωριστές εικόνες, Εκατομμύρια χρόνια πριν καυτή ηφαιστειακή λάβα ξεχύθηκε από τα έγκατα της γης και μόλις ήρθε σε επαφή με το θαλασσινό νερό πάγωσε. Και έτσι έγιναν αυτά τα εντυπωσιακά γλυπτά που τα λένε Φραγκοκέφαλα. Οι δεκάδες αποχρώσεις κίτρινου χρώματος της παγωμένης λάβας και οι σφαιροειδείς γεωλογικοί σχηματισμοί διπλά στους γραφικούς ορμίσκους της θάλασσας εντυπωσιάζουν τους επισκέπτες. Αξίζει να τα επισκεφτείτε…

(Τάσος Ναρλιώτης, 7 Ιουνίου 2020, https://www.facebook.com/groups/1090462624321556/?multi_permalinks=3298573386843791%2C32980386768972 62&notif_id=1591628464834086&notif_t=group_activity)

Το Χάος, ένα γεωλογικό θαύμα της Αττικής

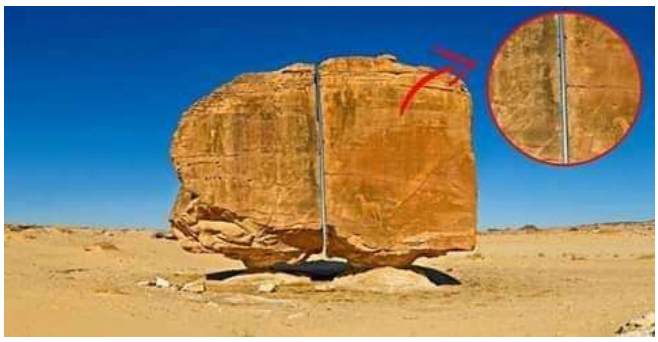
Το Έγκοιλο χάος ή χάος του Κίτσου, όπως το ονομάζει η τοπική λαογραφία από το όνομα διαβόητου ληστή που έδρασε στην περιοχή τον 19ο αιώνα, είναι ένα πραγματικό γεωλογικό θαύμα της Αττικής. Μέσα στον εθνικό δρυμό του Σουνίου, σε μια περιοχή που φημίζεται για την πλούσια μεταλλευτική της δραστηριότητα ήδη από την προϊστορική εποχή, το χαώδες καρστικό βύθισμα με βάθος 55 μέτρα συναρπάζει με το μεγαλείο του και θυμίζει ένα παρόμοιο γεωλογικό θαύμα στα Δίδυμα Αργολίδας, τις περίφημες Δολίνες. Το Χάος βρίσκεται σε μικρή απόσταση και από τα λατομεία της Αμυγδαλέζας από όπου αντλήθηκε το μάρμαρο τόσο για τον ναό του Ποσειδώνα όσο και του ναού της Αθήνας Σουνιάδος. Οι φήμες ότι είναι

αποτέλεσμα πτώσης μετεωρίτη δεν ευσταθούν ενώ μελετάται η πιθανότητα να ήταν σπηλαιοβάραθρο του οποίου κατέρρευσε η οροφή.



Ἐγκοιλο Χάος, Άγιος Κωνσταντίνος (Καμάριζα), Λαύριο Αττικής

Megalith in Tamya Oasis in Saudi Arabia



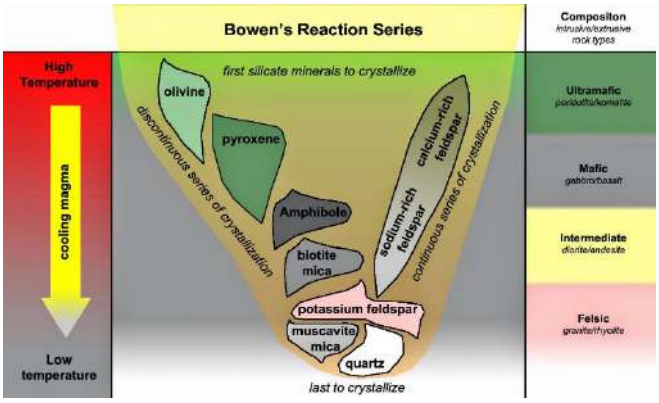
Located at the Tamya Oasis in Saudi Arabia is a fascinating megalith called Al-Naslaa. It is perfectly split in half and has curious symbols portrayed on its surface.

If that wasn't enough, the two rocks split in half with laser-like precision have managed to remain standing for centuries, and are somehow perfectly balanced.

(Becky Sivley / Ancientology, 14 Ιουνίου 2020, https://www.facebook.com/groups/1090462624321556/?multi_permalinks=3323019634399166&notif_id=1592429717355061&notif_t=group_activity

https://www.facebook.com/photo.php?fbid=1650380085128358&set=pcb.3076297902458925&type=3&theater&ifg=1)

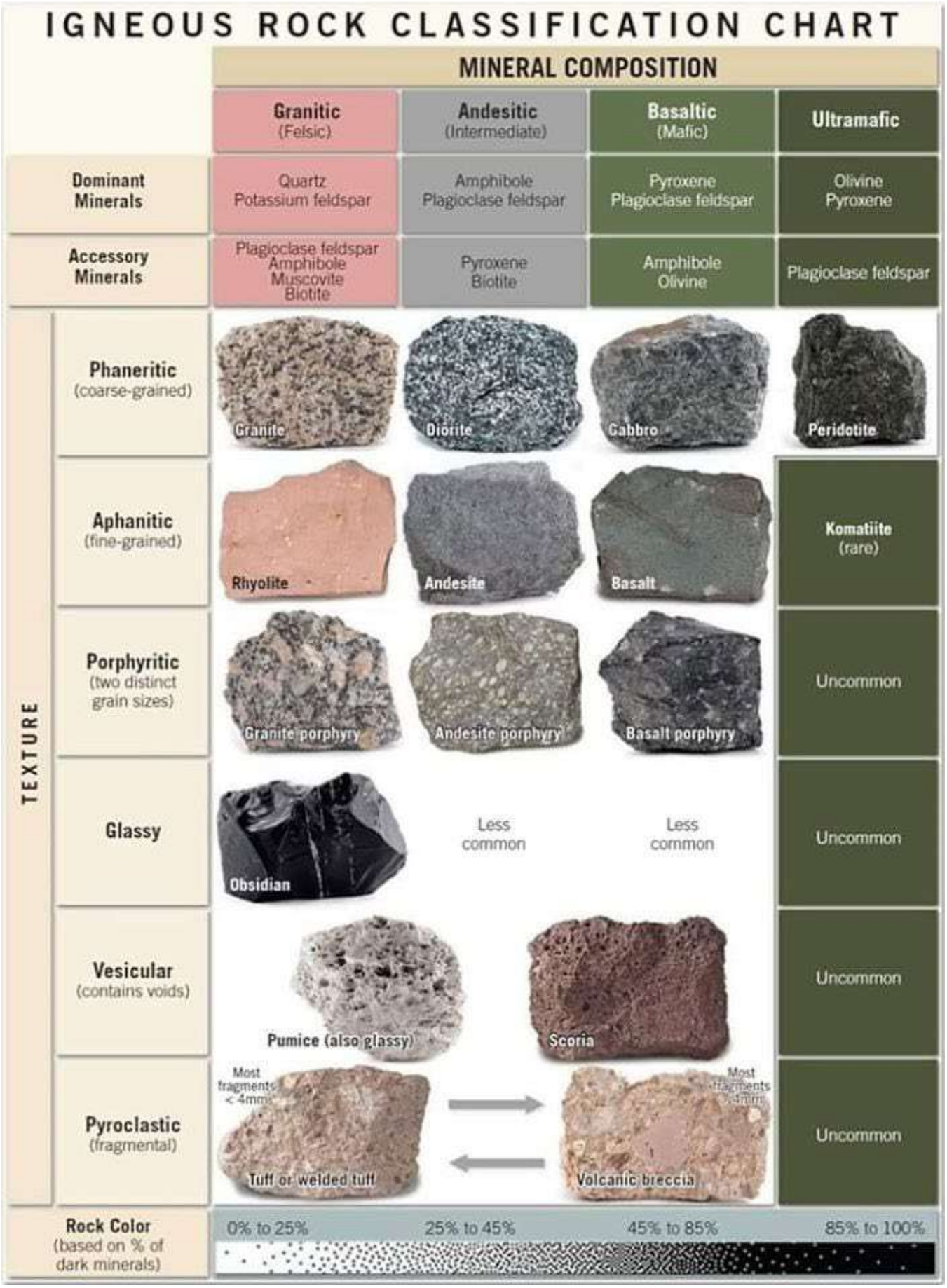
Bowen's Reaction Series



The Bowen reaction series is a description of how magma's minerals change as they cool. It's a means of ranking common igneous silicate minerals by the temperature at which they crystallise. Bowen's Reaction Series describes the temperatures at which different common silicate minerals change from the liquid to solid phase (or from the solid to liquid).

http://www.geologyin.com/2014/09/how-does-bowens-reaction-series-relate.html

IGNEOUS ROCK CLASSIFICATION CHART



ΕΝΔΙΑΦΕΡΟΝΤΑ - ΠΕΡΙΒΑΛΛΟΝ

Λίμνη Στράτου (στον ποταμό Αχελώο)

https://www.youtube.com/watch?v=JrTlLQ3_vYA&feature=share&fbclid=IwAR01W_Ocs996HItK6fDuvoe6HjBrRabD2dfOL9iRqtXX_GfJQXbYUStx6GA

Η Λίμνη Στράτου είναι τεχνητή λίμνη που δημιουργήθηκε με φράγμα στον ποταμό Αχελώο, με συνολική έκταση 8.400 km2. Η παρόχθια βλάστηση, η εναλλαγή χρωμάτων και ο πλούτος του οικοσυστήματος μετέτρεψαν τον τόπο από έργο ενέργειας και άρδευσης σ' έναν από τους πλουσιότερους υδροβιότοπους της χώρας.

Η Λίμνη Στράτου που βρίσκεται στο εννιά χιλιόμετρα δυτικά της πόλεως του Αγρινίου κατασκευάστηκε από την ΔΕΗ το 1991. Η διώρυγα απαγωγής του φράγματος αποτελεί πίστα θαλασσίου σκι.

Το τοπίο που έχει δημιουργηθεί είναι μοναδικό και η επίσκεψη στη λίμνη και στα υπέροχα παραλίμνια χωριά της ανταμείβει τον επισκέπτη.

Giannis Giannakopoulos

Στον Ρου του Αχελώου

Ποταμός "των πάντων άρχων" έλεγαν οι αρχαίοι τον Αχελώο ποταμό. Όμως η ανθρώπινη δύναμη και θέληση τον δάμασε πολλαπλά. Κατ' αρχή τον τιθάσευσε ο Ηρακλής στην μυθική πάλη μαζί του. Και τα σύγχρονα χρόνια ο άνθρωπος επενέβη και χρησιμοποίησε την τεράστια δύναμη του ποταμού για την παραγωγή ηλεκτρικής ενέργειας δημιουργώντας τρία διαδοχικά φράγματα. Έτσι σχηματίστηκαν τρεις λίμνες στον ρου του ποταμού. Και οι τρεις είναι πανέμορφες και αποτελούν ήδη μοναδικούς υδροβιοτόπους...

Το μικρό οδοιπορικό του βίντεο είναι από την γέφυρα του Αυλακιού έως τις εκβολές του ποταμού.

https://www.youtube.com/watch?v=Ryy6RicEbPQ

Giannis Giannakopoulos

There is space for carbon storage underground

Capturing it remains a challenge. But there should be no lack of permanent safe carbon storage underground.

Carbon storage underground is better than leaving the gas in the atmosphere

There is plenty of room for more of the main greenhouse gas on this planet – as long as it's caught and trapped in carbon storage underground. New research confirms that when it comes to storage space, there should be no problem about carbon capture and sequestration, known to climate engineers as simply CCS.

Carbon capture is written into intergovernmental plans to combat climate change: the theory is that in addition to stepping up investment in renewable energy such as solar and wind power, existing power plants that run on coal, oil and gas could trap the waste carbon dioxide and literally take it out of atmospheric circulation.

How and on what scale this could be done is still a matter for global debate. But at least there is no problem about whether

there is safe storage for the compressed and liquefied greenhouse gas.

New analysis from two scientists at Imperial College London in the journal Energy & Environmental Science suggests that if capture and storage accelerates now and continues at a growing rate, along with other recommended action, then no more than about 2,700 billion tonnes of carbon dioxide would need to be pumped back down abandoned oil shafts and other reservoirs, to keep global warming to less than 2°C above pre-industrial levels by 2100. This is an international target agreed in Paris in 2015.

Differences persist

Since most calculations conclude that there could be available subterranean storage space for around 10,000 billion tonnes of the gas, this suggests that storage itself is not the problem.

CCS sounds like a good idea: the prosecution of that idea has been contentious. Some climate scientists have worried that it is a distraction from the real challenge: to stop burning coal, oil and gas.

Others have been concerned with the lack of public investment; yet others have been troubled by the bigger question of whether a potentially volatile greenhouse gas can be kept in the ground safely for many thousands of years.

So CCS is at most only part of the answer to the problem: nations still have to make the switch to renewable sources, use all energy more efficiently, adjust global dietary demand and take steps to restore the world's great forests to prevent climate catastrophe: one in which planetary average temperatures surpass 3°C, and sea levels rise by up to a metre before the end of the century.

The first attempts to store industrial carbon dioxide exhaust began in Norway in 1996 and although progress has been faltering, over the past 20 years capacity has grown by 8.6 per cent to about 40 million tonnes a year: the Intergovernmental Panel on Climate Change (IPCC) now incorporates CCS as part of the mix of actions needed to contain runaway climate change.

The gap is colossal: right now the world emits 37 billion tonnes, or 37 Gt, of the greenhouse gas every year into the atmosphere to drive ever-faster planetary warning. The technology has a long way to go.

"Nearly all IPCC pathways to limit warming to 2°C require tens of gigatonnes of CO2 stored per year by mid-century. However, until now we didn't know if these targets were achievable, given historic data, or how these targets related to subsurface storage requirements," said Christopher Zahasky, who did the study at Imperial College but who has now moved to the University of Wisconsin-Madison.

"We found that even the most ambitious scenarios are unlikely to need more than 2700 Gt of CO2 storage resource globally, much less than the 10,000 Gt of storage resource that leading reports suggest is possible. Our study shows that if climate change targets are not met by 2100, it won't be for lack of carbon capture and storage space."

Who will pay?

The researchers considered not the space available but the pace of CCS advance: the faster carbon dioxide is safely stowed away, the less the overall need for subterranean hideaway space. But finally, the answer depends on all the other challenges presented by climate change.

"Our analysis shows good news for CCS if we keep up with this trajectory," said Samuel Krevor of Imperial College, a co-author. "But there are many other factors in mitigating climate change and its catastrophic effects, like using cleaner energy and transport as well as significantly increasing the efficiency of energy use."

Commenting on the study, Myles Allen, a geoscientist at the University of Oxford, said: "The good news, from this paper, is that there is a solution.

"The bad news is that CO2 capture and disposal is still completely dependent on public money, which will be in short supply over the coming decade. We have to work out other ways of scaling it up."

This story was published with permission from Climate News Network.

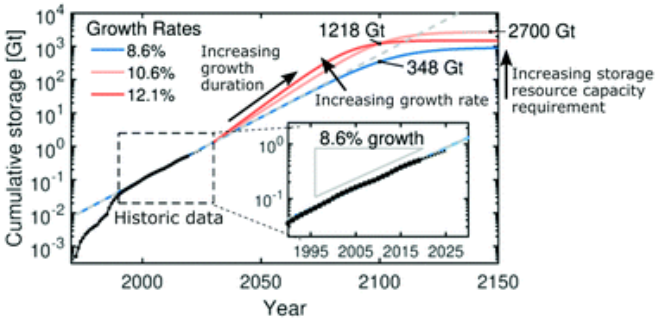
(Tim Radford, Climate News Network, May 28, 2020, https://www.eco-business.com/news/there-is-space-for-carbon-storage-underground)

Global geologic carbon storage requirements of climate change mitigation scenarios

Christopher Zahasky and Samuel Krevor

Abstract

Integrated assessment models have identified carbon capture and storage (CCS) as an important technology for limiting climate change. To achieve 2°C climate targets, many scenarios require tens of gigatons of CO_2 stored per year by mid-century. These scenarios are often unconstrained by growth rates, and uncertainty in global geologic storage assessments limits resource-based constraints. Here we show how logistic growth models, a common tool in resource assessment, provide a mathematical framework for stakeholders to monitor short-term CCS deployment progress and long-term resource requirements in the context of climate change mitigation targets. Growth rate analysis, constrained by historic commercial CO_2 storage rates, indicates sufficient growth to achieve several of the 2100 storage targets identified in the assessment reports of the Intergovernmental Panel on Climate Change. A maximum global discovered storage capacity of approximately 2700 Gt is needed to meet the most aggressive targets, with this ceiling growing if CCS deployment is delayed.



https://pubs.rsc.org/en/content/articlelanding/2020/ee/d0ee00674b#!divAbstract

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

Τα ΟΡΥΚΤΑ και ο ΑΝΘΡΩΠΟΣ - Τα ΟΡΥΚΤΑ και η ΤΕΧΝΗ

ΤΟ ΑΡΙΣΤΟΤΕΛΕΙΟ ΜΟΥΣΕΙΟ ΦΥΣΙΚΗΣ ΙΣΤΟΡΙΑΣ ΘΕΣΣΑΛΟΝΙΚΗΣ-ΑΜΦΙΘ (Συνέργεια Α.Π.Θ. και Δήμου Θεσσαλονίκης), που βρίσκεται στην αρχική φάση δημιουργίας του και στα πρώτα βήματα λειτουργίας του, *ως μονάδα του Α.Π.Θ. μη κερδοσκοπικού χαρακτήρα, στην υπηρεσία της κοινωνίας, ανοικτό στο κοινό, που έχει ως έργο του τη συλλογή και την παρουσίαση τεκμηρίων του περιβάλλοντος, με στόχο τη μελέτη, την εκπαίδευση και τον πολιτισμό,* φιλοξένησε μια ιδιαίτερα επιτυχημένη έκθεση «*Τα ΟΡΥΚΤΑ και ο ΑΝΘΡΩΠΟΣ - Τα ΟΡΥΚΤΑ και η ΤΕΧΝΗ*» σε συνεργασία με το Μουσείο Γουλανδρή Φυσικής Ιστορίας και τη χορηγία του Συνδέσμου Μεταλλευτικών Επιχειρήσεων Ελλάδος (ΣΜΕ), υπό την αιγίδα του Α.Π.Θ. και ελεύθερη είσοδο. Η έκθεση ξεκίνησε την 7η Οκτωβρίου 2019 και τερματίστηκε στις αρχές Μαρτίου 2020, λόγω των δυσμενών συνθήκων. Τα εγκαίνια της πραγματοποιήθηκαν από τον Πρόεδρο της Ελληνικής Δημοκρατίας κ. Προκόπη Παυλόπουλο.

Η επιτυχία της προσπάθειάς αυτής αποτυπώνεται στους αριθμούς επισκεψιμότητας και στο μεγάλο ενδιαφέρον που εκδηλώθηκε στην πόλη της Θεσσαλονίκης από πολλούς φορείς και από την προβολή των ΜΜΕ. Κατέδειξε στο ευρύτερο κοινό, επιστημονικά τεκμηριωμένα, με εκλαϊκευμένο τρόπο, μέσα από καλαίσθητες προθήκες και σύγχρονη μουσειολογική προσέγγιση, τη μεγάλη ποικιλία ορυκτών και πετρωμάτων, ιδιαίτερα του ελλαδικού χώρου. Με τα πολύχρωμα, όμορφα δείγματα, με τις επιστημονικές πληροφορίες, αλλά κυρίως με τις πάρα πολλές χρήσεις τους και εφαρμογές τους. Υπήρξε μια έκθεση εξαιρετικού ενδιαφέροντος με Εκπαιδευτικές, Εικαστικές και Πολιτιστικές προεκτάσεις για όλες τις ηλικίες. Έφερε το ευρύτερο κοινό και ιδιαίτερα τους μαθητές, κοντά στη χρησιμότητα των υλικών της μητέρας Γης στην καθημερινή μας ζωή και τόνισε τη διαχρονική συμβολή τους στην εξέλιξη του ανθρώπινου πολιτισμού.

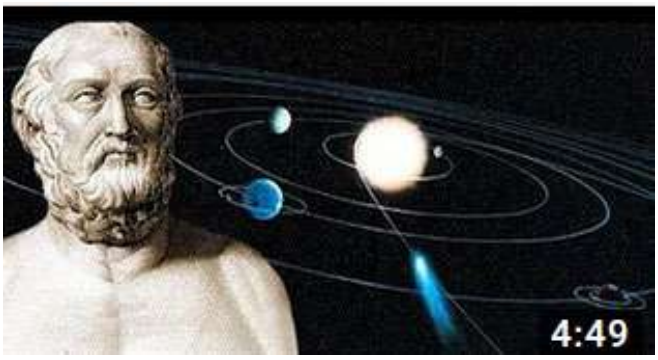
Την επιτυχία της Έκθεσης σφραγίζει το μεγάλο ενδιαφέρον των Θεσσαλονικέων και Βορειοελλαδιτών και κυρίως η μεγάλη προσέλευση με την επισκεψιμότητα να προσεγγίζει τις 30.000 επισκέπτες στους πέντε (5) μήνες λειτουργίας της, τόσο σε μαθητές (11.000) όλων των βαθμίδων της εκπαίδευσης, όσο πολλών μεμονωμένων επισκεπτών, ομάδων συλλόγων-σωματείων (15.000), ακόμη και αλλοδαπών τουριστών (2.600), με 230 οργανωμένες ξεναγήσεις και 4 δημόσιες διαλέξεις. Στην επιτυχία της Έκθεσης συνέβαλε επίσης η αγαστή συνεργασία του Συνδέσμου Μεταλλευτικών Επιχειρήσεων, της Epi Direct - Public Relations**,** αρκετών μελών του Α.Μ.Φ.Ι.Θ., που αφιλοκερδώς προσφέρουν τις υπηρεσίες τους και ιδιαίτερα των **30 εθελοντών φοιτητών-συνεργατών** μας του Τμήματος Γεωλογίας, ακούραστων ξεναγών της έκθεσης και στο συντονιστή τους Καθηγητή Βασίλη Μέλφο. Ευχαριστίες προσωπικά οφείλονται στους Χ. Σ. Χιντήρογλου, Κοσμήτορα της ΣΘΕ και Αντιπρόεδρο του ΔΣ, καθώς και στον Άκη Αγγελίδη, Γραμματέα του ΔΣ και Προέδρου του Σωματείου Φίλων του Μουσείου, που συνεχώς και ακούραστα αντιμετώπιζαν όλα τα προβλήματα της διοργάνωσης. Επίσης στους Αθανάσιο Κεφάλα και Χρήστο Καβαλόπουλο, Προέδρο και Διευθυντή του ΣΜΕ αντίστοιχα, στον Σχεδιαστή της Έκθεσης Λ. Θεοδωρόπουλο του Μουσείου Γουλανδρή και τους συνεργάτες του, τη συνάδελφο Γεωλόγο Ε. Δήμου, καθώς και στην κ. Λήδα Παπαδοπούλου και το ακούραστο προσωπικό της Epi Direct για την άψογη επαγγελματική τους συνεισφορά. Τέλος, τους ομιλητές όλων των εκδηλώσεων και ιδιαίτερα Χ. Καβαλοπουλο, Β. Μελφο, Κ. Νικολάου, Α. Φιλιππίδη, Ν. Αρβανιτίδη. Το ΔΣ του Α.Μ.Φ.Ι.Θ. **ευχαριστεί θερμά** όλους τους παραπάνω συντελεστές της επιτυχούς Έκθεσης.

Το Αριστοτέλειο Μουσείο Φυσικής Ιστορίας Θεσσαλονίκης είναι πλέον ένας θεσμός στην Πόλη της Θεσσαλονίκης, στη Μακεδονία και Βόρεια Ελλάδα, που ήδη έχει βάλει τη σφραγίδα του στην πόλη και στους πολίτες της, με εκθέσεις όπως η πρόσφατη «Ορυκτά και Άνθρωπος».

Θεσσαλονίκη 5 Ιουνίου 2020

Ο Πρόεδρος του ΔΣ του ΑΜΦΙΘ
Σπύρος Παυλίδης, Ομότιμος Καθηγητής

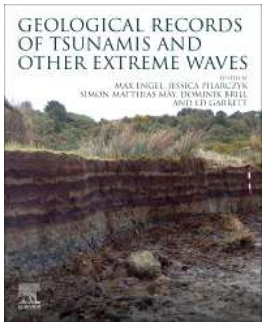
Carl Sagan: Το Αριστάρχειο ηλιοκεντρικό σύστημα



Ο διάσημος αστροφυσικός και συγγραφέας Carl Sagan, παρουσιάζει την πρόταση του Έλληνα φιλόσοφου Αρίσταρχου του Σάμιου, σύμφωνα με την οποία ο Ήλιος αποτελεί το κέντρο του ηλιακού συστήματος. Ο Αρίσταρχος παρατηρώντας το μέγεθος της σκιάς της Γης πάνω στη Σελήνη, συμπέρανε ότι ο Ήλιος πρέπει να είναι πολύ μακριά, και επίσης ότι είναι πολύ μεγαλύτερος από τη Γη. Θεώρησε ότι δεν είναι λογικό ένα πολύ μεγαλύτερο ουράνιο σώμα να κινείται γύρω από ένα μικρότερο, όπως η Γη. Αυτό είναι το ηλιοκεντρικό μοντέλο, σε αντίθεση με το γεωκεντρικό, το οποίο πρότεινε τη Γη ως το κέντρο του κόσμου. **Την πρόταση του Αρίσταρχου γνώριζε και ο Κοπέρνικος ο οποίος πρότεινε το ίδιο μοντέλο 17 αιώνες αργότερα, και μάλιστα είχε και παραπομπή στον Αρίσταρχο, την οποία όμως αφαίρεσε στην τελική έκδοση. Έτσι το ηλιοκεντρικό μοντέλο έχει επικρατήσει ως «Κοπερνίκειο», ενώ θα έπρεπε να λέγεται «Αριστάρχειο».**

https://www.youtube.com/watch?v=2xFpkvGTwKE

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ



Geological Records of Tsunamis and Other Extreme Waves 1st Edition

Editors: Max Engel, Jessica Pilarczyk, Simon Matthias May, Dominik Brill, Ed Garret

Description

Geological Records of Tsunamis and Other Extreme Waves provides a systematic compendium with concise chapters on the concept and history of paleotsunami research, sediment types and sediment sources, field methods, sedimentary and geomorphological characteristics, as well as dating and modeling approaches. By contrasting tsunami deposits with those of competing mechanisms in the coastal zone such as storm waves and surges, and by embedding this field of research into the wider context of tsunami science, the book is also relevant to readers interested in paleotempestology, coastal sedimentary environments, or sea-level changes, and coastal hazard management.

The effectiveness of paleotsunami records in coastal hazard-mitigation strategies strongly depends on the appropriate selection of research approaches and methods that are tailored to the site-specific environment and age of the deposits. In addition to summarizing the state-of-the-art in tsunami sedimentology, *Geological Records of Tsunamis and Other Extreme Waves* guides researchers through establishing an appropriate research design and how to develop reliable records of prehistoric events using field-based and laboratory methods, as well as modeling techniques.

Key Features

- Features a comprehensive overview of the state of the art in tsunami sedimentology and paleotsunami research
- Offers advice on the most appropriate mapping, sampling, and analytical approaches for a wide variety of coastal settings and sedimentary environments
- Provides methodological details for field sampling and the most important proxy analyses

Readership

Geologists, Geochemists, Sedimentologists, Coastal Geomorphologists, Seismologists, Coastal Planners

(Elsevier, 17th July 2020)

Soil Mechanics

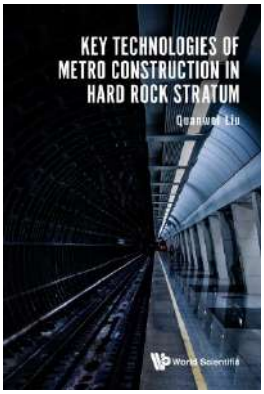
Hongjian Liao, Hangzhou Li and Zongyuan Ma

This book also doubles as a textbook with an explanation of basic theory, knowledge, and skills in soil mechanics as well as the most updated codes and standards in China. Also included are guidelines at the beginning of each chapter and English–Chinese–Japanese translations of frequently-used words and expressions in the Appendix. It aims to be a reference book for students and technical staff in civil engineering, hydraulic engineering, mining engineering, and transportation engineering.

- **Contents:**
- Preface
- Basic Characteristics and Engineering Classification of Soils
- Permeability of Soil and Seepage Force
- Stress Distribution in Soils
- Compression and Consolidation of Soils
- Shear Strength
- Bearing Capacity
- Stability of Slopes
- Lateral Earth Pressure and Retaining Walls
- Constitutive Model of Soil and Characteristics of Special Soil
- Appendix

Readership: Students in civil engineering, hydraulic engineering, mining engineering, and transportation engineering.

(World Scientific, October 2020)



Key Technologies of Metro Construction in Hard Rock Stratum

Quanwei Liu

This book is a comprehensive and objective study of the theory and construction methods of metro construction in hard rock stratum. It is based on the construction of the Qingdao metro and provides key techniques for metro construction in hard rock stratum in a systematic manner. Detailed data, accurate charts and pictures are provided to guide future metro construction in hard rock stratum in China.

Divided into six chapters, *Key Technologies of Metro Construction in Hard Rock Stratum* covers various construction technologies in hard rock stratum including (1) drilling and

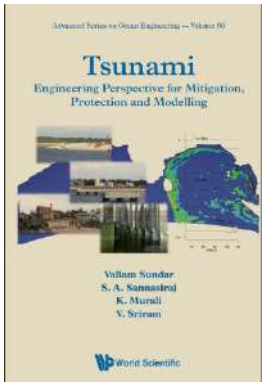
blasting construction technology, (2) open-cut station construction technology, (3) subsurface excavated station construction technology, (4) grouting reinforcement technology in adverse geological section, and (5) standardized metro construction technology. It can be used as reference for design, construction, monitoring or supervision staff as well as teachers and students engaged in metro and underground construction to facilitate exchange of ideas.

Contents:

- Introduction
- Drilling-Blasting Tunnel Construction Technology in Hard Rock Stratum
- Open-Cut Station Construction Technology
- Subsurface Excavated Station Construction Technology
- Grouting Reinforcement Technology of Poor Geological Section
- Green Construction and Standardized Site Construction

Readership: The main target audience are technical personnel of metro construction.

(World Scientific, September 2020)



Advanced Series on Ocean Engineering: Volume 50

Tsunami

Engineering Perspective for Mitigation, Protection and Modeling

V Sundar, S A Sannasiraj, K Murali and V Sriram

The most pertinent tsunami related issues such as water borne debris during tsunami flooding, design loads to incorporate for impact forces on coastal zone infrastructure, detection and warning are meticulously incorporated in this book.

Modelling of various coastal processes have proven to be successful in the recent past, which includes extreme events such as storm surge, cyclone, etc. The possible provisions for computational/numerical tsunami modelling and real physical modelling in laboratory are elaborated. The propagation, evolution and run-up of tsunami waves and their associated non-linear dynamics are discussed.

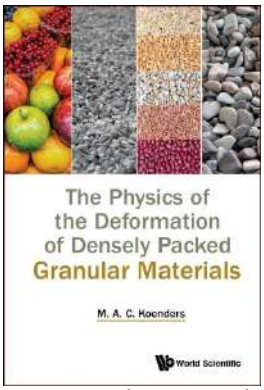
The significant inferences from the experts who have had hands-on experience working with the extensive magnitude of a tsunami disaster reported on the signature studies and post-facto effects of the 2004 Indian Ocean Tsunami, with respect to the damages along the Indian coast.

Contents:

- ***Overview:***
  - Tsunami: Generation, Propagation and Effects
  - Tsunami-Driven Debris and Its Impact
  - Tsunami Hazards and Aspects on Design Loads
- ***Field Studies:***
  - Behaviour of Shoreline between Groyne Field and Its Effect on the Tsunami Propagation
  - Signature Studies (Tamil Nadu, Kerala, Andaman and Nicobar Islands)
  - Post Facto Evaluation along Tsunami Affected Stretches
- ***Physical Modelling:***
  - Tsunami Detection
  - Effectiveness of Coastal Vegetation on Impacts due to Tsunami
  - Tsunami Generation in Laboratory
- ***Numerical Modelling:***
  - Tsunami Propagation Modeling
  - Tsunami Evolution and Run-up
  - Tsunami Impact Modeling

Readership: Researchers and graduate students interested in tsunamis, tsunami mitigation, tsunami protection and modelling.

(World Scientific, June 2020)



The Physics of the Deformation of Densely Packed Granular Materials

M A C Koenders

This book is of interest for those that are concerned professionally with granular materials: civil engineers, geologists and geophysicists, chemical engineers, pharmacists, food technologists, agriculturalists, biologists and astronomers.

Granular materials play a role in nearly all human activities. For example, users of sand, from children in sandpits to sophisticated geotechnical engineers, know that it is a fascinating — and to some extent, unpredictable — material. In addition to sand, which itself may be of many compositions, there are various types of materials including gravel, fine-particle aggregates as employed in cosmetics, pharmaceuticals, dust, crushed rock and granules that occur in a domestic environment, such as breakfast cereals, sugar, salt and (instant or ground) coffee granules.

The aim of the book is to present a theory that explains the physics behind the phenomena during the deformation of densely packed granular media. The physics that describes such features is rather subtle and is developed from the micro to macro level (the latter is the continuum mechanics level that is used in practical applications). It requires the analysis of anisotropy and the heterogeneity of the packing evaluated against the background of a frictional inter-particle interaction.

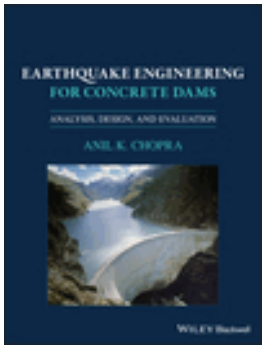
Contents:

- Preface
- About the Author

- General Concepts
- Continuum Mechanics and Cartesian Tensor Calculus
- The Bounds of Static Equilibrium
- Heterogeneity
- Fabric Description
- Stress-Strain Relations of Granular Assemblies: A Frictionless Assembly
- Stress-Strain Relations of Granular Assemblies: Normal and Tangential Interactions
- Frictional Granular Materials
- Appendix A: Mathematical Appendix
- Appendix B: List of Symbols and Notations
- Index

Readership: Mathematical physicists, civil engineers (especially soil mechanics), chemical engineers with a special interest in cake formation, geologists; applied mathematicians.

(World Scientific, March 2020)



Earthquake Engineering for Concrete Dams: Analysis, Design, and Evaluation

Anil K. Chopra

A comprehensive guide to modern-day methods for earthquake engineering of concrete dams

Earthquake analysis and design of concrete dams has progressed from static force methods based on seismic coefficients to modern procedures that are based on the dynamics of dam–water–foundation systems. *Earthquake Engineering for Concrete Dams* offers a comprehensive, integrated view of this progress over the last fifty years. The book offers an understanding of the limitations of the various methods of dynamic analysis used in practice and develops modern methods that overcome these limitations.

This important book:

- Develops procedures for dynamic analysis of two-dimensional and three-dimensional models of concrete dams
- Identifies system parameters that influence their response
- Demonstrates the effects of dam–water–foundation interaction on earthquake response
- Identifies factors that must be included in earthquake analysis of concrete dams
- Examines design earthquakes as defined by various regulatory bodies and organizations
- Presents modern methods for establishing design spectra and selecting ground motions
- Illustrates application of dynamic analysis procedures to the design of new dams and safety evaluation of existing dams.

Written for graduate students, researchers, and professional engineers, *Earthquake Engineering for Concrete Dams* offers a comprehensive view of the current procedures and methods for seismic analysis, design, and safety evaluation of concrete dams.

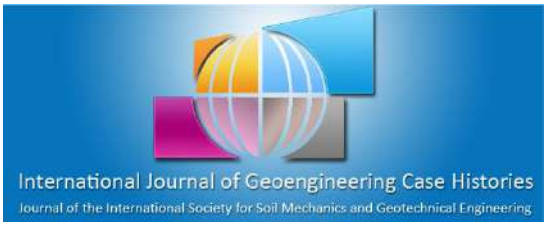
(John Wiley & Sons Ltd, 7 February 2020)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

https://www.issmge.org/publications/issmge-bulletin/vol-14-issue-3-june2020

Κυκλοφόρησε το Τεύχος 3 του Τόμου 14 (Ιουνίου 2020) του ISSMGE Bulletin με τα παρακάτω περιεχόμενα:

- **Research highlights**
- **Major project – Rock Fill Concrete Arch Dam**
- **TC Corner**
  - Inauguration of the TC107 Symposium
  - First international administrative meeting of the TC305
- **Conference report – Indo-China Research Webinar Series**
- **ISSMGE Foundation reports**
- **Event Diary**
- **Corporate Associates**
- **Foundation Donors**



An official journal of the International Society for Soil Mechanics and Geotechnical Engineering
www.geocasehistoriesjournal.org/pub/issue/view/45

Κυκλοφόρησε το Τεύχος 3 του Τόμου 45 του του International Journal of Geoengineering Case Histories με τα παρακάτω περιεχόμενα:

Application of Hybrid Drained-Undrained Model for Analyzing the Stability of Reinforced Soil Structures Over Soft Foundations with Prefabricated Vertical Drains David Espinoza, Chunling Li, Lucas de Melo, Ranjiv Gupta

Pressuremeter Testing Along Interstate 10 in Tucson, Arizona Naresh C. Samtani

https://www.isrm.net/adm/newsletter/ver_html.php?id_newsletter=189

Κυκλοφόρησε το Τεύχος 50 (Ιουνίου 2020) του Newsletter της International Society for Rock Mechanics με τα παρακάτω περιεχόμενα:

- Message from the President
- 30th ISRM Online Lecture by Dr. Gen-Hua Shi
- EUROCK 2020 continues as planned 12-14 October 2020
- ISRM International Workshop on ″Recent Trends in Rock Mechanics″ held in Ljubljana Volume 22 - 2019 of the ISRM News Journal is online
- ISRM Rocha Medal 2022 nominations
- Professor François Cornet passed away
- ISRM Sponsored Conferences

Κυκλοφόρησε το IGS Newsletter της International Geosynthetics Society με τα παρακάτω περιεχόμενα:

IGS NEWSLETTER – June 2020

Helping the world understand the appropriate value and use of geosynthetics

https://www.geosyntheticssociety.org/newsletters/

- 10 Questions With…IGS President Chungsik Yoo **READ MORE**
- EuroGeo7 Postponed To Next Year READ MORE
- IGS Voting Ends 15 June, Cast Your Ballots Now! READ MORE
- IGS Young Members: Down to Earth – An interview with Edoardo Zannoni READ MORE
- Activities in progress of CEN TC 189 on "Geosynthetics" READ MORE
- Case Study: Reinforcement Of Slopes Of The Moscow Ring Road With Weld-Free Geocell Geostep® READ MORE
- IGS Corporate Member Pre-Sale Exclusive for GeoAsia7 READ MORE
- Turkey Chapter Conference Adjourned READ MORE
- IGS Chile Launches Barriers Committee READ MORE
- Calendar of Events

READ MORE AT GEOSYNTHETICSSOCIETY.ORG

https://www.icevirtuallibrary.com/toc/jgein/27/3

Κυκλοφόρησε το Τεύχος 3 του Τόμου 27 (Ιουνίου 2020) του Geosynthetics International της International Geosynthetics Society με τα παρακάτω περιεχόμενα:

Load transfer mechanism in geosynthetic reinforced column-supported embankments, M. Wijerathna, D. S. Liyanapathirana, 27(3), pp. 236–248

Analytical solution for geogrid-reinforced piled embankments under traffic loads, Y. Zhuang, X. Cheng, K. Wang, 27(3), pp. 249–260

A case study on geogrid-reinforced and pile-supported widened highway embankment, W. Lu, L. Miao, F. Wang, J. Zhang, Y. Zhang, H. Wang, 27(3), pp. 261–274

Load-deformation of piled embankments considering geosynthetic membrane effect and interface friction, Tuan A. Pham, 27(3), pp. 275–300

Geosynthetic-reinforced pile-embankments: numerical, analytical and centrifuge modelling, M. S. S. Almeida, D. F. Fagundes, L. Thorel, M. Blanc, 27(3), pp. 301–314

Geosynthetic-reinforced pile-supported embankment: settlement in different pile conditions, P. Shen, C. Xu, J. Han, 27(3), pp. 315–331

Technical notes

Load transfer and deformation of geogrid-reinforced piled embankments: field measurement, A. Khansari, L. Vollmert, 27(3), pp. 332–341

Quantitative performance evaluation of GRPE: a full-scale modeling approach, T. Lee, S. H. Lee, I.-W. Lee, Y.-H. Jung, 27(3), pp. 342–347

https://www.sciencedirect.com/journal/geotextiles-and-geomembranes/vol/48/issue/3

Κυκλοφόρησε το Τεύχος 3 του Τόμου 48 (Ιουνίου 2020) του Geotextiles and Geomembrabes της International Geosynthetics Society με τα παρακάτω περιεχόμενα:

Editorial Board Page ii

Regular Articles

Tension force analysis of geotextile tubes by half cross-section test, H.J. Kim, P.R. Dinoy, H.S. Kim, Pages 243-256

Geofoam blocks to protect buried pipelines subjected to strike-slip fault rupture, Habib Rasouli, Behzad Fatahi, Pages 257-274

Field assessment of railway ballast degradation and mitigation using geotextile, Raghvendra Pratap Singh, Sanjay Nimbalkar, Saurabh Singh, Deepankar Choudhury, Pages 275-283

Stochastic evaluation of leakages through holes in wrinkle networks of composite liners, Cheng Chen, Liang-tong Zhan, Yu Wang, Shuai Zhang, Yun-min Chen, Pages 284-296

Design method for quantifying embankment safety against lateral spreading and determining contribution of basal reinforcements, Cihan Oser, S. Feyza Cinicioglu, Ozer Cinicioglu, Pages 297-305

Vertical compression of soft clay within PVD-improved zone under vacuum loading: Theoretical and practical study, Yan-Bin Gao, Zhen Zhang, Pages 306-314

Seismic performance of a whole Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS) in shaking table test, Chao Xu, Minmin Luo, Panpan Shen, Jie Han, Feifan Ren, Pages 315-330

Numerical study of creep effects on settlements and load transfer mechanisms of soft soil improved by deep cement mixed soil columns under embankment load, Pei-Chen Wu, Wei-Qiang Feng, Jian-Hua Yin, Pages 331-348

Stability analysis of stone column-supported and geosynthetic-reinforced embankments on soft ground, Gang Zheng, Xiaoxuan Yu, Haizuo Zhou, Shun Wang, ... Xinyu Yang, Pages 349-356

Performance of geosynthetic-reinforced soil foundations across a normal fault, Kuo-Hsin Yang, Jung Chiang, Chao-Wei Lai, Jie Han, Ming-Lang Lin, Pages 357-373

Static structural behavior of geogrid reinforced soil retaining walls with a deformation buffer zone, He Wang, Guangqing Yang, Zhijie Wang, Weichao Liu, Pages 374-379

Fully coupled analysis of consolidation by prefabricated vertical drains with applications of constant strain rate tests: Case studies and an open-source program, Hung Tien Pham, Wolfram Rühaak, Dong Huy Ngo, Oanh Cong Nguyen, Ingo Sass, Pages 380-391

Barrier properties of a geosynthetic clay liner using polymerized sodium bentonite, Jin-Chun Chai, Nutthachai Prongmanee, Pages 392-399

Combining EPS geofoam with geocell to reduce buried pipe loads and trench surface rutting, S.N. Moghaddas Tafreshi, N. Joz Darabi, A.R. Dawson, Pages 400-418

Technical Note

Internal stability analysis of reinforced convex highway embankments considering seismic loading, Shangchuan Yang,

Yufeng Gao, Ben Leshchinsky, Kai Cui, Fei Zhang, Pages 221-229

Shear strength evaluation of composite pavement with geotextile as reinforcement at the interface, Shyue Leong Lee, Mohammad Abdul Mannan, Wan Hashim Wan Ibrahim, Pages 230-235

Reclamation of abandoned open mines with innovative meandrically arranged geotextiles, Jan Broda, Petra Franitza, Ulrich Herrmann, Reinhard Helbig, ... Monika Rom, Pages 236-242

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2019 – 2022)

Πρόεδρος	:	Μιχάλης ΜΠΑΡΔΑΝΗΣ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΣ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Α.Ε. mbardanis@edafos.gr, lab@edafos.gr
Α' Αντιπρόεδρος	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr
Β' Αντιπρόεδρος	:	Μιχάλης ΠΑΧΑΚΗΣ, Πολιτικός Μηχανικός mpax46@otenet.gr
Γενικός Γραμματέας	:	Γιώργος ΜΠΕΛΟΚΑΣ, Δρ. Πολιτικός Μηχανικός, Επίκουρος Καθηγητής ΤΕΙ Αθήνας gbelokas@teiath.gr, gbelokas@gmail.com
Ταμίας	:	Γιώργος ΝΤΟΥΛΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε.- ΓΕΩΤΕΧΝΙΚΕΣ ΜΕΛΕΤΕΣ Α.Ε. gdoulis@edafomichaniki.gr
Έφορος	:	Γεώργιος ΓΚΑΖΕΤΑΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής Ε.Μ.Π. gazetas@central.ntua.gr, gazetas50@gmail.com
Μέλη	:	Ανδρέας ΑΝΑΓΝΩΣΤΟΠΟΥΛΟΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής ΕΜΠ aanagn@central.ntua.gr
		Παναγιώτης ΒΕΤΤΑΣ, Πολιτικός Μηχανικός, ΟΜΙΛΟΣ ΤΕΧΝΙΚΩΝ ΜΕΛΕΤΩΝ Α.Ε. otmate@otenet.gr
		Μαρίνα ΠΑΝΤΑΖΙΔΟΥ, Δρ. Πολιτικός Μηχανικός, Αναπληρώτρια Καθηγήτρια Ε.Μ.Π. mpanta@central.ntua.gr
Αναπληρωματικά Μέλη	:	Χρήστος ΣΤΡΑΤΑΚΟΣ, Πολιτικός Μηχανανικός, ΝΑΜΑ Α.Ε. stratakos@namalab.gr
		Βάλια ΞΕΝΑΚΗ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. vxenaki@edafomichaniki.gr
Εκδότης	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr

ΕΕΕΕΓΜ

Τομέας Γεωτεχνικής
ΣΧΟΛΗ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ
ΕΘΝΙΚΟΥ ΜΕΤΣΟΒΙΟΥ ΠΟΛΥΤΕΧΝΕΙΟΥ
Πολυτεχνειούπολη Ζωγράφου
15780 ΖΩΓΡΑΦΟΥ

Τηλ. 210.7723434
Τοτ. 210.7723428
Ηλ-Δι. secretariat@hssmge.gr ,
geotech@central.ntua.gr
Ιστοσελίδα www.hssmge.org (υπό κατασκευή)

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» Εκδότης: Χρήστος Τσατσανίφος, τηλ. 210.6929484, τοτ. 210.6928137, ηλ-δι. ctsatsanifos@pangaea.gr, editor@hssmge.gr, info@pangaea.gr

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» «αναρτώνται» και στην ιστοσελίδα www.hssmge.gr