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ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ
& ΓΕΩΤΕΧΝΙΚΗΣ
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ΓΚΑΖΕΤΑΣ Γεώργιος
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ΑΡΘΡΑ

Cyclic resistance and shear stiffness properties of a clean sand stabilized with colloidal silica

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ABSTRACT This paper presents results from a laboratory investigation into passive site stabilization of liquefiable sands by injecting colloidal silica (CS). In order to examine the improvement of the cyclic resistance and shear stiffness of liquefiable sands stabilized with CS, cyclic triaxial and bender element tests were performed on a clean quartz sand stabilized with two different concentrations of CS. The stabilized sample preparation method adopted in the tests is initially described and then results from the above tests conducted on treated and untreated samples are presented. It is shown that stabilization of the sand with CS significantly improves the cyclic resistance, as well as the shear stiffness. Whereas the increase in CS concentration does not influence the cyclic resistance of the stabilized sand, it results in the increase of shear stiffness.

1 INTRODUCTION

Liquefaction of sandy soils is one of the major causes of damage of earth structures and foundations during earthquakes. Over the last decades, widespread liquefaction-induced ground deformation and related damage to foundations has occurred, as a result of urban expansion and building on liquefaction-prone sites. Thus mitigation and preventing damage, due to liquefaction under existing developed sites, is one of main issues of seismic design. To this end, the technique of passive site stabilization of liquefiable soil under existing structures has been proposed (Gallagher & Mitchell 2002). This method is based on the use of nanomaterials, such as colloidal silica, laponite and bentonite, and involves slow injection of the stabilization nanomaterial into the liquefiable soil by means of natural or augmented groundwater flow.

Colloidal silica (CS) is an aqueous suspension of microscopic silica particles, produced from saturated solutions of silicic acid, H_4SiO_4 (Iler 1979). In dilute solutions, CS has a density and viscosity similar to those of water and can be made to gel by adjusting the ionic strength or pH of a given CS solution. This property allows it to be injected or mixed with soil, so that after gelling colloidal silica blocks the void space in the soil and therefore alters its mechanical behaviour. The principal advantages of CS over other potential stabilizers are its excellent durability characteristics, its initial low viscosity and the ability to attain low permeability in grouted soils, long controllable and reproducible gel times, non-toxicity and low cost.

Previous research on the mechanical behaviour of sands stabilized with CS mainly involved unconfined compressive strength tests and physical modelling tests. Monotonic and cyclic triaxial testing on sands stabilized with CS are reported in literature among a few others by Kabashima & Towhata (2000), Gallagher & Mitchell (2002), Díaz-Rodriguez et al. (2008) and Mollamahmutoglu & Yilmaz (2010). Reported studies concerning the shear stiffness of sands stabilized with CS are even more limited and have been mainly conducted by means of resonant column and centrifuge model tests.

With increasing application of passive site stabilization, however, there is need to better understand both the strength and stiffness characteristics of liquefiable sands that are stabilized with CS under different loading conditions, as well as to assess the limits of the applicability of this improvement method. Vranna & Tika (2015) investigated the monotonic and cyclic behaviour of a clean sand stabilized with CS with 10% concentration and the work presented herein is an extension to the above work. To this end, a series of cyclic and bender element tests was performed on a clean quartz sand, stabilized with two different CS concentrations, of 6% and 10%. The effectiveness of the CS stabilization was investigated by conducting also a series of cyclic and bender element tests on untreated sand samples. The results from the two series of tests are presented and discussed.

2 EXPERIMENTAL PROCEDURE

2.1 Tested materials

The soil used in this study is a natural clean quartz sand (M31) with grains of variable roundness and sphericity. It has a specific gravity G_s = 2.655, maxi-mum and minimum void ratios of e_{max} = 0.805 and e_{min} = 0.558 respectively, a mean diameter D_{50} = 0.31mm and a uniformity coefficient of C_u = 1.5. Its gradation curve lies within the bound gradation curves, suggested for liquefiable soils.

Ludox SM-30 was selected as the stabilizing agent of sand samples, supplied as a 30% by weight silica solution with a viscosity of 5.5cP, a pH of 10 and an average particle size of 7nm. Distilled water was added to the initial solution in order to obtain concentrations of 6% and 10% CS. Gel times of the two studied solutions were investigated by conducting viscosity measurement tests, by means of a rotating Brookfield viscometer (Vranna & Tika 2015). It is noted that gel time was defined as the elapsed time for which the tested solution viscosity is equal to η = 3.5cP. Beyond that value, viscosity increases rapidly and eventually the solution transforms into a rigid gel.

It was decided to employ CS gel times equal to 10 and 11 hours for the 10% and 6% CS solution, respectively. These times were achieved by adjusting the pH value to pH = 6.0, as well as the appropriate NaCl concentration of each solution.

2.2 Testing programme

The testing programme consisted of undrained isotropically consolidated cyclic triaxial tests on untreated, as well as CS treated sand samples. All tests were performed using a closed-loop automatic cyclic triaxial apparatus (M.T.S. Systems Corporation), equipped with bender elements.

Cylindrical samples (height/diameter ≈ 100mm / 50mm) were prepared at various densities, using the undercompaction method, as proposed by Ladd (1978), both for the untreated and treated sand. Saturation was achieved by percolating throughout the sample, first carbon dioxide gas (CO_2) and then de-aired water. The CS solution was then injected into the samples until it filled the soil voids. The replacement of water by the CS solution was considered to be complete when a solution volume equal to four times the soil sample volume was extracted from the top of the sample. The viscosity of the CS solution remained low (η < 3.5cP) throughout the sample percolation process.

After the setting of CS, treated samples were placed in a constant temperature and humidity chamber for a curing time of five times the CS gel time. Saturation of treated samples prior to testing was not performed, due to the infilling of pore spaces with CS and the possibility of damaging the formed CS bonds. It was assumed, therefore, that total confining, p_0, and effective confining, p'_0, stresses, coincide.

All samples were isotropically consolidated under p'_0 ranging from 20 to 600kPa.

During cyclic loading, a sinusoidally varying axial stress ($\pm\sigma_d$) was applied at a frequency of f = 0.1Hz, under undrained conditions. In this work, the occurrence of double amplitude axial strain, ε_{DA} = 5% is used as a reference point to define cyclic softening of both treated and untreated samples. For this reason, a series of cyclic triaxial tests with different cyclic stress ratios, CSR = σ_d / $2p'_0$, was carried out in order to determine the number of load cycles, N, required for the development of ε_{DA} = 5% both for the treated and untreated samples. In view of the typical number of load cycles of actual earthquakes (10 to 20 for an earthquake of M7.5 magnitude), the onset of cyclic softening and thus the cyclic resistance ratio, CRR_{15}, is considered as the CSR required to produce ε_{DA} = 5% in 15 loading cycles. In this work, cyclic loading of the samples was conducted at p'_0 = 100kPa.

The bender elements were installed in specially constructed top and bottom platens of the cylindrical sample. A function generator was used for the excitation of the source element (top platen) with an electrical signal. A digital oscilloscope was used for the display and recording of both the input-source and output-receiver signals. The function generator and the oscilloscope were connected to a computer. The type of electrical signal used to drive the source element was a sinusoidal pulse of 10Volts (amplitude) at a frequency ranging from 3 to 10kHz. An automated measurements system was developed for signal acquisition and analyses which included recording, appropriate filtering and automated measurement of travel time of the signal in time and frequency domain (Theopoulos 2009).

The shear waves travel time through the samples was determined using the start-to-start (Kawaguchi et al. 2001) and cross correlation (Mancuso et al. 1989) methods, respectively. To account for the near field effect disturbances, due to the arrival of P waves before shear waves at the receiver element, as well as signal noises, signal arrival was observed by passing waves of different frequencies (Brignoli et al. 1996). According to the start-to-start method, when the first amplitude in the time history of the receiver signal matches the direction of source signal, the point where the receiver signal takes-off from the base line (horizontal line of zero voltage when there is no signal) is the time of shear wave arrival. In case the first amplitude in the time history of the receiver signal does not match the direction of source signal, the point where the receiver signal first transverses towards the source signal direction and intersects the base line, is the time of shear waves arrival. According to the cross correlation method, the arrival of shear waves at the receiver element is identified by the maximum of the cross-correlation function of the source and receiver signals.

For the untreated samples, the shear waves travel times determined by the start-to-start and cross-correlation methods, were practically identical. However, for the treated samples, problems were encountered in determining the shear waves travel time, using the start-to-start method. Due to this uncertainty, the cross correlation method was used for the estimation of the travel time for both types of samples. Measurements of shear wave velocity, V_s, were conducted after completion of consolidation and prior to cyclic loading.

3 TEST RESULTS AND ANALYSIS

3.1 Cyclic resistance

Figure 1a compares the cyclic response of loose untreated and treated samples of similar void ratios, e, also subjected to similar CSR (0.23 to 0.25) under p'_0 = 100kPa. It is indicated that the untreated sand experiences much larger strain in fewer loading cycles, N, than the corresponding treated samples. Whereas the values of N at ε_{DA} = 1, 2.5 and 5% are very close for the untreated sample, for the treated samples with both CS = 6% and 10% there is a distinct difference between N at ε_{DA} = 2.5 and 5%. For the latter samples, ε_{DA} increases gradually during cyclic loading. Figures 1b and c show the excess pore water pressure ratio, $\Delta u/p'_0$, evolution in time and the stress path in the deviatoric stress, q = σ'_a-σ'_r, versus mean effective stress, p' = (σ'_a+2σ'_r)/3, space, respectively, for the untreated sample. As seen for the untreated samples, ε_{DA} increases rapidly and complete liquefaction ($\Delta u/p'_0$=98%) is reached at ε_{DA} = 3%. The same pattern of behaviour was also observed at different e and CSR values.

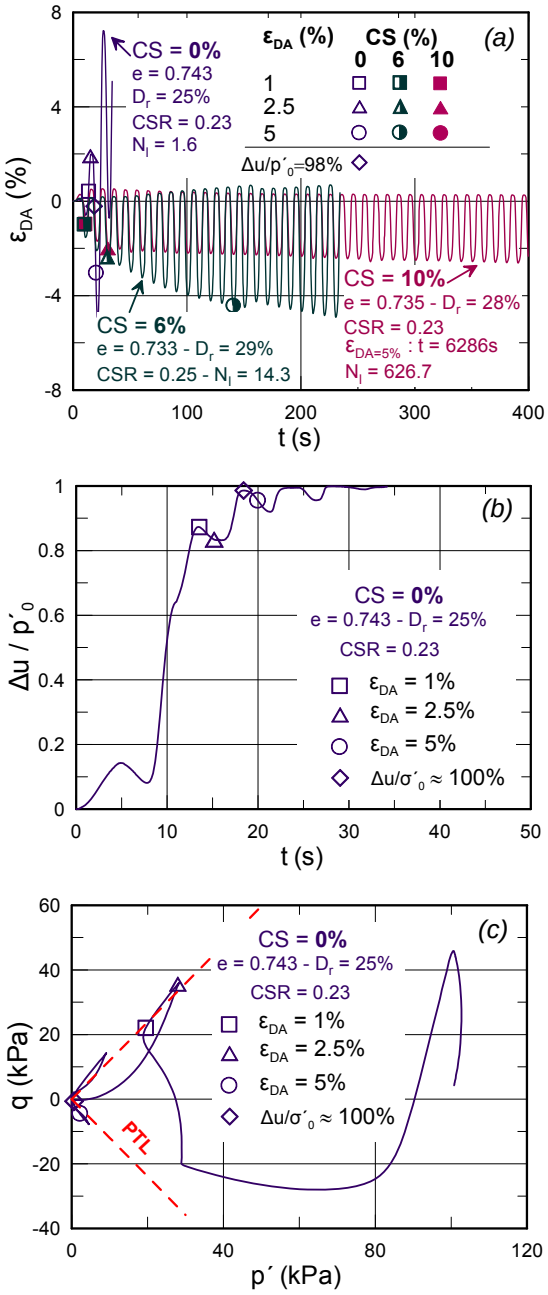

Figure 1. (a) Variation of double amplitude axial strain, ε_{DA} with time, t, for treated and untreated sands, for e = 0.733-0.743 and CSR ≈ 0.23 under p'_0 = 100kPa. (b) Variation of normalized excess pore water pressure, $\Delta u/p'_0$, with time, t, and (c) deviatoric stress, q, with mean effective stress, p', for the untreated sand of Fig. 1a.

Figure 2 presents for various N values the CSR required to reach three levels of ε_{DA} = 1, 2.5 and 5%, for the treated samples at a loose state with CS = 6% (Figure 2a) and 10% (Figure 2b), under p'_0 = 100kPa. The numbers of cy-

cles required to reach ε_{DA} = 1, 2.5 and 5% are considerably different from each other for both CS = 6% and 10%.

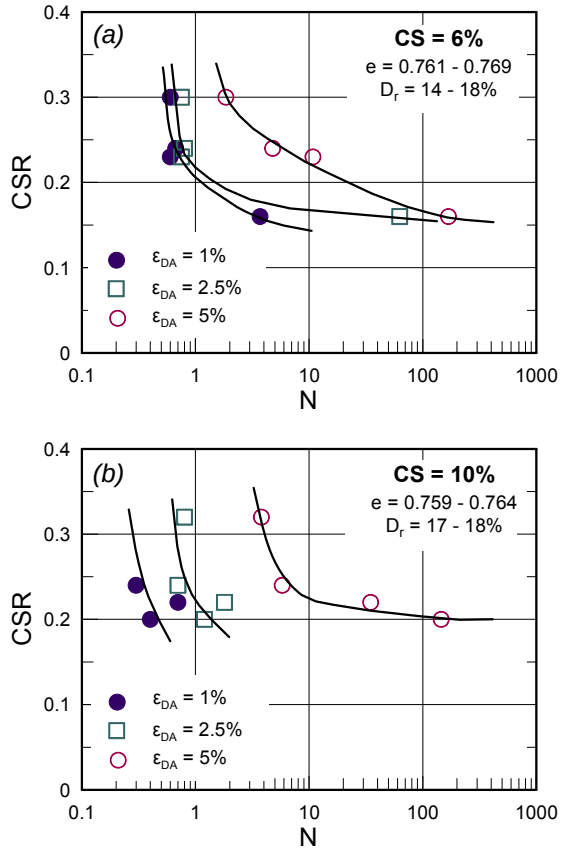

Figure 2. Variation of CSR, with number of cycles N, for treated samples with (a) CS = 6% and (b) 10%, at various values of ε_{DA}, at p'_0 = 100kPa.

Figure 3a presents the variation of CSR with number N_l at ε_{DA} = 5%, for treated and untreated samples at a loose state, at p'_0 = 100kPa. There is a remarkable increase of N_l for treated samples as compared to the corresponding of the untreated. Furthermore, it is shown that the N_l values for samples with CS = 6% and 10% are very similar with each other at high CSR values. The same observation holds for treated samples at a medium dense state.

The variation of CRR_{15} with e, for untreated and treated sands at p'_0 = 100kPa, is presented in Figure 3b. It is shown that treated sands exhibit practically identical CRR_{15}, irrespectively of the CS concentration, which is at least double the cyclic resistance of untreated sands, under p'_0 = 100kPa, for the studied range of densities.

3.2 Shear stiffness

The small-strain shear modulus, G_{max}, defined as the linear elastic shear modulus, can be determined from V_s by the following equation:

$$G_{max} = V_s^2 \cdot \rho \quad (1)$$

where ρ is total mass density of the soil and it can be expressed by the following empirical equation (Jamiolkowski et al. 1991):

$$G_{max} = A \cdot p_a^{1-m} \cdot e^n \cdot p'^m_0 \quad (2)$$

where p_a is a reference stress, assumed to be 100 kPa, and A, m and n are parameters dependent on soil type.

The small-strain shear modulus, G_{max}, was estimated from the measured V_s values in the bender element tests using equation (1). Table 1 lists the values of parameters A, m and n derived for the untreated and treated sands, according to equation (2). Figure 4 presents the results from the bender element tests. To correct for the effect of density, G_{max} was normalized using the void ratio function, $f(e) = e^n$. It is shown that both the presence and concentration of CS have a positive effect on the small-strain shear modulus of treated samples. For the CS concentration used in this work, the increase of normalized small-strain shear modulus of treated samples, $[G_{max}/f(e)]_{treated}$, over that of the untreated, $[G_{max}/f(e)]_{untreated}$, increases with both p'_0 and CS, as shown in Figure 5. At CS = 6% and $p'_0 \leq$ 50kPa, there is no effect of CS stabilization on the shear stiffness of the sand. At $p'_0 \geq$ 100kPa, the treated samples with CS = 10% show 35% higher values of normalized shear stiffness, than the corresponding values of the treated samples with CS = 6%.

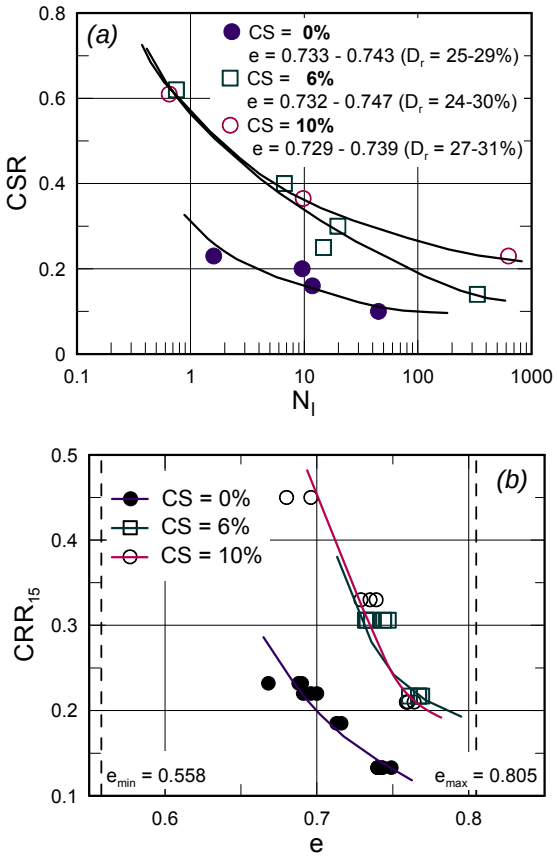

Figure 3. Variation of (a) CSR, with number of cycles, N_l, required for ε_{DA} = 5% and (b) CRR_{15} with void ratio, e, for treated and untreated samples, at p'_0 = 100kPa.

Table 1. Values of parameters A, m and n derived from bender element tests.

CS (%)	A (10^3)	m	n	(r^2)*
0	381.221	0.545	-6	0.960
6	381.221	0.545	-6.5	0.983
10	381.221	0.545	-5	0.982

(*) coefficient of correlation

Figure 6 presents the correlation of CRR_{15} with shear wave velocity, V_s, for treated and untreated sands at p'_0 = 100kPa. It is indicated that the rate of increase of CRR_{15} with V_s increases with both CS presence and concentration.

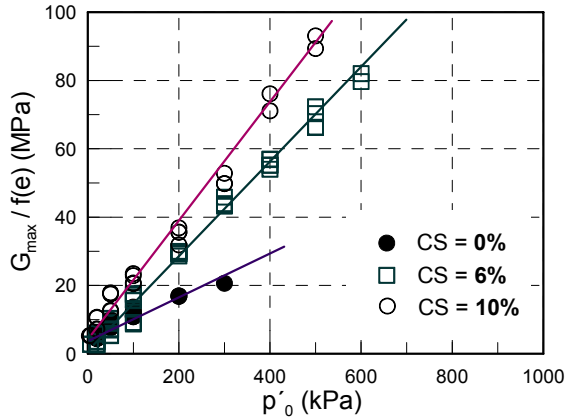

Figure 4. Variation of normalized small-strain shear modulus, G_{max} / f(e), with effective mean stress, p'$_0$, for treated and untreated samples.

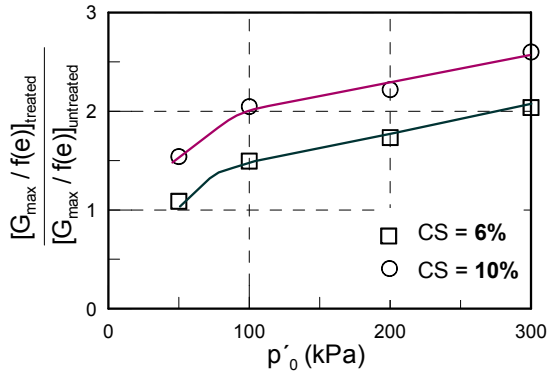

Figure 5. Increase of normalized shear stiffness ratio, G_{max} / f(e) of treated samples over the corresponding of untreated.

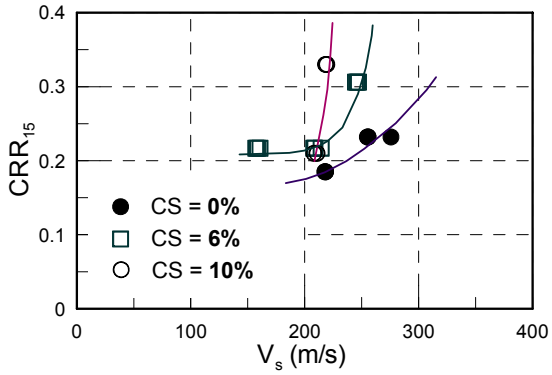

Figure 6. Correlation of cyclic resistance ratio, CRR_{15}, with shear wave velocity, V_s, at p'$_0$ = 100kPa for treated and untreated samples.

4 CONCLUSIONS

The following conclusions can be drawn from the results of this work on the behaviour of sands stabilized with CS = 6% and 10% and under the range of stresses and densities studied:

a) CS stabilization improves significantly both the cyclic resistance and the shear stiffness of the treated samples.

b) the treated samples exhibit increased deformation resistance to cyclic loading, as compared to untreated samples which experience much larger ε_{DA} in fewer cycles.

c) treated sands exhibit approximately double the cyclic resistance of untreated sands, irrespectively of CS concentration.

d) both the CS presence and concentration have a positive effect on shear stiffness. At a given CS concentration and density, the increase of small-strain shear modulus of the treated samples over that of the untreated, increases with p'$_0$.

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Με το άρθρο αυτό συμμετέσχε η πρώτη των συγγραφέων στο 24th Young Geotechnical Engineers Conference.

ΑΠΟΤΕΛΕΣΜΑΤΑ ΔΙΑΓΩΝΙΣΜΟΥ ΔΙΠΛΩΜΑΤΙΚΗΣ ΕΡΓΑΣΙΑΣ ΕΦΑΡΜΟΣΜΕΝΟΥ ΕΝΔΙΑΦΕΡΟΝΤΟΣ ΓΙΑ ΤΟ ΕΤΟΣ 2015

Οι διπλωματικές εργασίες που εκπονούνται από τους τελειοφοίτους των Τμημάτων Πολιτικών Μηχανικών είναι δυνατόν να επιλύσουν προβλήματα είτε ερευνητικού ή πρακτικού ενδιαφέροντος. Στην πρώτη περίπτωση, υπάρχουν αρκετές εναλλακτικές δυνατότητες δημοσίευσης υλικού από την διπλωματική. Αντίθετα, όταν η διπλωματική έχει κυρίως εφαρμοσμένο προσανατολισμό, οι δυνατότητες δημοσιοποίησης είναι περιωρισμένες.

Η βράβευση διπλωματικών εφαρμοσμένου ενδιαφέροντος αποσκοπεί στο να αναπληρώσει αυτό το κενό και να ενθαρρύνει την εκπόνηση διπλωματικών υψηλών προδιαγραφών με εφαρμοσμένο αντικείμενο. Σταδιακά, όλα τα ελληνικά πολυτεχνεία διαθέτουν το ψηφιακό περιεχόμενο των διπλωματικών εργασιών στο διαδίκτυο, οπότε αυτή η πρωτοβουλία της ΕΕΕΕΓΜ θα βοηθήσει στην περαιτέρω διάχυση της πληροφορίας.

Στον εφετεινό διαγωνισμό για την καλύτερη διπλωματική εργασία εφαρμοσμένου ενδιαφέροντος συμμετείχαν οι παρακάτω συνάδελφοι με τις αντίστοιχες εργασίες:

Ειρήνη Γεωργίου «Στατική και Δυναμική Απόκριση Κοίλων Κυλινδρικών Φρεάτων υπό Συνδυασμένη Τριδιάστατη Φόρτιση» (Επιβλέπων Καθηγητής Γ. Γκαζέτας, Σχολή Πολιτικών Μηχανικών ΕΜΠ)

Αριάδνη Ελμαλόγλου «Τι μπορεί να πετύχει η Παρακολουθούμενη Φυσική Εξασθένηση σε χώρους ρυπασμένους με χλωροαιθένια» (Επιβλέπουσα Καθηγήτρια Μ. Πανταζίδου, Σχολή Πολιτικών Μηχανικών ΕΜΠ)

Τριανταφυλλιά Κάκου «Προσδιορισμός της Παραμένουσας Αντοχής Αναμοχλευμένων Αργίλων με Εργαστηριακές Δοκιμές Δακτυλιοειδούς Διάτμησης» (Επιβλέπων Καθηγητής Γ. Αθανασόπουλος, Τμήμα Πολιτικών Μηχανικών Πολυτεχνικής Σχολής Πανεπιστημίου Πατρών)

Αξιολόγηση των υποβληθεισών εργασιών έγινε από επιτροπή τριών (3) γεωμηχανικών, μελών της ΕΕΕΕΓΜ, εκ των οποίων οι δύο είναι γεωμηχανικοί της πράξης (μελετητές) και ο τρίτος διδάσκων γεωμηχανικής σε πανεπιστήμιο εξωτερικού (Κώστας Ιωαννίδης, Θανάσης Πλατής και Σταυρούλα Κοντοέ, αντίστοιχα).

Η επιτροπή κατέληξε, ομόφωνα, στην βράβευση της εργασίας της συναδέλφου Ειρήνης Γεωργίου. Το βραβείο συνοδεύεται από τιμητική εγγραφή και διετή δωρεάν συνδρομή στην ΕΕΕΕΓΜ και στην ISSMGE.

Η επίσημη βράβευση θα γίνη στο προσεχές πανελλήνιο συνέδριο της ΕΕΕΕΓΜ το 2018.

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

24ο Ευρωπαϊκό Συνέδριο Νέων Γεωμηχανικών, Durham, UK

Το 24ο Ευρωπαϊκό Συνέδριο Νέων Γεωμηχανικών, «European Young Geotechnical Engineers Conference», πραγματοποιήθηκε στο Durham του Ηνωμένου Βασιλείου στις αρχές Σεπτεμβρίου 2015. Το Συνέδριο οργανώθηκε από την British Geotechnical Association (BGA), την International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) και τους καθ. David Toll και Δρ. Ashraf Osman (Durham University).

Οι συμμετέχοντες στο συνέδριο «24th European Young Geotechnical Engineers Conference», Durham, Ηνωμένο Βασίλειο, 11 - 12 Σεπτεμβρίου 2015.

Παρουσιάστηκαν 37 εργασίες από εκπροσώπους των χωρών της Ευρώπης. Η θεματολογία των εργασιών αφορούσε στη μελέτη της εδαφικής συμπεριφοράς, θεμελιώσεις, τοίχους αντιστήριξης, ευστάθεια πρανών και σήραγγες.

Παρουσιάστηκαν επίσης δύο προσκεκλημένες διαλέξεις από τους Richard Jardine (Καθηγητής, Imperial College) και Stuart Haigh (Λέκτορας, Cambridge University), με αντικείμενο την εργαστηριακή διερεύνηση της μηχανικής συμπεριφοράς γεωλογικά γηρασμένων εδαφών και τη συμπεριφορά υπεράκτιων αιολικών πάρκων, αντίστοιχα.

Τα συμπεράσματα του Συνεδρίου παρουσιάστηκαν στο 16ο Συνέδριο Γεωτεχνικής Μηχανικής «XVI ECSMGE - Geotechnical Conference for Infrastructure and Development» που πραγματοποιήθηκε αμέσως μετά, στο Εδιμβούργο της Σκωτίας (14 - 17 Σεπτ.).

Την Ελλάδα εκπροσώπησε στο συνέδριο η Αντιγόνη Βράννα, υποψήφια Διδάκτορας στο ΑΠΘ.

Η εκπρόσωπος της ΕΕΕΕΓΜ κατά την παρουσίαση του άρθρου της.

ISSMGE Council Meeting

Η Γενική Συνέλευση (Council Meeting) της ISSMGE διεξήχθη την Κυριακή 13 Σεπτεμβρίου 2015 στο Edinburgh International Conference Centre με την παρακάτω θεματολογία:

1. Opening remarks by President Roger Frank and agreement of the Agenda.

2. List of Delegates and other persons present - Apologies for absence by the General Secretary Neil Taylor.

3. Confirmation of quorum (Statute 12K).

4. Confirmation of Minutes of the Paris Council Meeting.

5. Membership: status and communication. Report by Secretary General.

6. Amendments to Statutes and Bylaws, re: Technical Committees.

Present Bylaw 16.1:

Technical Committees may be instituted at the request of a group of members interested in a specific topic and with the knowledge and agreement of the President and Secretary General. Suggestions of topics for the work of Technical Committees should be submitted by Member Societies to the Secretary General six months before the President takes office.

Proposed Bylaw 16.1:

Technical Committees may be instituted at the request of a group of members interested in a specific topic and with the knowledge and agreement of the President and Secretary General. Guidelines for the operation of Technical Committees are published on the ISSMGE website.

The amendments were accepted by the Council.

7. Cooperation Agreement for the Federation of International Geo-engineering Societies.

The proposal was accepted by the Council.

8. Regional Reports by Vice-Presidents on Regional Activities.

Fatma Baligh - Africa, Ikuo Towhata - Asia, Mark Jaksa – Australasia, Antonio Gens - Europe, Paul Mayne – North America, Jarbas Milititsky - South America.

Board Level Committees

Reports on activities by Chairs of the Board Level Committees

9. Innovation and Development Committee by Dimitris Zekkos.

10. Technical Oversight Committee by Pierre Delage.

11. Young Members' Presidential Group, by Jennifer Nicks.

12. Corporate Associates' Presidential Group, by Sukumar Pathmanandavel.

13. Award Committee by Charles Ng.

14. Professional Image Committee by Sherif Wissa.

15. International Webinars.

16. International Seminars.

17. International Journal of Geo-Engineering Case Histories.

18. The ISSMGE Bulletin.

19. FedIGS report.

20. Presentation of Audited Accounts 2013, 2014 by Secretary General Neil Taylor.

21. Budget 2015 – 2017 by Mark Jaksa.

22. The ISSMGE Foundation.

23. IXX ICSMGE, Seoul 2017. Oral report by KGS

24. The next Council Meeting will be held in Seoul, 2017.

SIMSG ISSMGE

XVI ECSMGE 2015
13-17 September 2015 - Edinburgh

BGA THE BRITISH GEOTECHNICAL ASSOCIATION

Geotechnical Conference for Infrastructure and Development

The conference was held in the Edinburgh International Conference Centre from 13th to 17th September 2015.

A total of 1,025 abstracts were submitted from 65 countries resulting in 701 papers being submitted from 55 countries. 676 papers were accepted for publication and these were joined by three keynote lecture papers, six invited lecture papers and the introductory paper giving 686 papers in all.

The seven volumes of the proceedings (Winter et al. 2015) weigh almost 10kg and at 4,784 pages form the largest under a single ISBN in its near-200 year history.

A total of 37 programmed additional meetings were held during the conference, largely ISSMGE Technical Committee meetings with a small number of International Geosynthetics Society (IGS) Technical Committee meetings. Also amongst these meetings were the ISSMGE Board meeting, which was held on the Saturday before the conference, and the ISSMGE Council meeting, which was held on Sunday 13 September along with many of the Technical Committee Meetings.

The attendance at the event included 992 delegates, 163 exhibitors and 71 accompanying person – a total of 1,226. All of the available information points to this being a substantial increase on the previous record for a conference in the ECSMGE series. Mike Chrimes, the Institution of Civil Engineer's recently retired historian, has also indicated that it is the largest conference on a civil engineering subject ever held in the United Kingdom.

65 countries were represented and 28 of those are from continents other than Europe.

The conference programme was designed to maximise the number of presentations and 383 papers were presented orally in nine plenary and 35 parallel sessions with 92 Chairs and UK Co-Chairs, excluding the Opening and Closing Ceremonies held on the Monday and Thursday respectively. In addition, 211 posters were presented. The conference also introduced, for, we believe, the first time to an ISSMGE event, e-Posters; these were available to authors of all papers whether presented orally or by poster and attracted 347 submissions that received more than 13,000 individual viewings.

Mike Winter
Conference Organizing Committee Chairman

Whisky tasting at the exhibition boots (Pierre Delage, Ecole Centrale Paris, Jonathan Fannin, University of British Columbia Canada, Σταυρούλα Κοντοέ, Imperial College, Γιούλη Δουλαλά-Rigby, TENSAR, Χρήστος Τσατσανίφος, ΕΕΕΕΓΜ και Φάνη Τσατσανίφου, ΠΑΝΓΑΙΑ

Στο συνέδριο συμμετείχαν 33 Έλληνες, εκ των οποίων οι 16 διαμένουν στην Ελλάδα (Αγαπουλάκη, Βουράκης, Βράννα, Γκαζέτας, Ζύμνης, Καραουλάνης, Κωμοδρόμος, Παπαβασιλείου, Παπαδημητρίου, Παχάκης, Κ. Πιτιλάκης, Τζιβάκος,

Τίκα, Τσατσανίφος, Τσάτσης και Χαλούλος) και 17 στο εξωτερικό [Αναστασόπουλος (ΗΒ), Γραμματικοπούλου (ΗΒ), Δασκαλόπουλος (ΗΒ), Δημητριάδη (ΗΒ), Δουλαλά-Rigby (ΗΒ), Ζανιά (Δανία), Ζέκκος (ΗΠΑ), Ιερωνυμάκη (ΗΠΑ), Καραμήτρος (ΗΒ), Κατσιγιάννης (ΗΒ), Κοντοέ (ΗΒ), Μαντίκος (ΗΒ), Ντούνης (ΗΒ), Παντελίδου (ΗΒ), Σταθοπούλου (Ολλανδία), Τσιαμπούση (ΗΒ) και Τσίτσας (Ρουμανία)].

Ο καθ. Γκαζέτας κατά τη παρουσίαση του άρθρου "Estimation of elastic and non-linear stiffness coefficients for suction caisson foundations"

Στα πρακτικά του συνεδρίου δημοσιεύθηκαν 62 άρθρα στη συγγραφή των οποίων συμμετείχαν Έλληνες συνάδελφοι. Εξ αυτών τα 34 υπεβλήθησαν μέσω της ΕΕΕΕΓΜ και τα υπόλοιπα 28 μέσω επιστημονικών εταιρειών του εξωτερικού. Τα άρθρα θα παρουσιασθούν σταδιακά στο περιοδικό. Σημειώνεται ότι τα άρθρα αυτά αποτελούν το 8.8% του συνολικού αριθμού των άρθρων του συνεδρίου! Όχι άσχημα για την χειμαζόμενη Ελλάδα!

Από το επίσημο δείπνο (Pierre Delage, Γιούλη Δουλαλά-Rigby, …, …, John Burland, Fatma Baligh, Roger Frank, … and Mark Jaksa)

Το άρθρο, στην συγγραφή του οποίου συμμετέσχε ο συνάδελφος Λ. Πελεκάνος "The role of distributed sensing in understanding the engineering performance of geotechnical structures" K. Soga, V. Kwan, L. Pelecanos, Y. Rui, T. Schwamb, H. Seo, M. Wilcock ήταν Keynote Paper, και παρουσιάσθηκε από τον καθ. Soga κατά την εναρκτήρια συνεδρία. Το άρθρο "Vulnerability assessment of buildings exposed to co-seismic permanent slope displacements" K.D. Pitilakis, S.D. Fotopoulou ήταν Invited Lecture Paper, και παρουσιάσθηκε από τον καθ. Πιτιλάκη στην έναρξη της MAIN SESSION B: Slopes, Geohazards & Problematic Materials, την Τρίτη 15 Σεπτεμβρίου.

SIMSG ISSMGE

ISSMGE European Member Societies Meeting

Η Γενική Συνέλευση (Council Meeting) των Ευρωπαϊκών χωρών της ISSMGE διεξήχθη την Τρίτη 15 Σεπτεμβρίου 2015 στο Edinburgh International Conference Centre.

The meeting was opened by Antonio Gens (AG), Vice-President Europe at 18:30.

1. *Opening remarks by Vice-President Europe and agreement of the Agenda*

AG thanked all the people present for attending the meeting. He gave a special welcome to Professors Heinz Brand and Ivan Vanicek (former Vice-Presidents for Europe) and to Professor Neil Taylor, Secretary General of ISSMGE. He also welcomed Dr. Andrew Bond, the Chairman of TC250/SC7 (Eurocode) who had agreed to attend the meeting to provide information concerning point 4 of the Agenda. The ISSMGE President, Roger Frank, apologized for his absence as he was attending a simultaneous meeting of the Technical Oversight Committee.

He thanked his colleagues Marcos Arroyo, Alberto Ledesma and Iván Puig for their help in keeping the minutes and for assistance in the subsequent voting processes.

The Agenda (Annex 1) had been circulated to all European Member Societies before the meeting. It was adopted with no objections from the delegates.

2. *List of Delegates and other persons present*

There was a roll call of delegates. The following European Member Societies were represented: Albania, Austria, Belgium, Bosnia & Herzegovina, Croatia, Czech and Slovak Republics, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Macedonia – FYR, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovenia, Spain, Sweden, Switzerland, Turkey, UK. A total of 32 (out of a possible 37). Ukraine has delegated their proxy vote to the Vice-President Europe.

An attendance list was circulated. The full list of participants is provided in Annex 2.

3. *Report from the Vice-President Europe*

The Vice-President Europe presented a summary report because many of the points had already been presented at the ISSMGE Council meeting held the previous Sunday, 13th September. He stressed the following points:

- There are currently very few countries in Europe that are not members of the ISSMGE (leaving aside very small counties such as Monaco or San Marino): Armenia,

Azerbaijan, Cyprus, Moldavia and Montenegro. Georgia re-joined the International Society at the time of the Paris International Conference. He was also happy to report that Cyprus is completing the final administrative stages in order to join ISSMGE shortly.

- AG emphasized the importance of the European Young Geotechnical Engineers Conference (EYGEC) for the future of the ISSMGE and of the geotechnical professionin general. He reported that a successful Conference had just been held in Durham (in connection with the Edinburgh European Conference). The 2016 EYGEC Conference will take place in Sibiu (Romania) from 21st to 24th June. In 2017 the Young Geotechnical Engineers Conference will be an international one associated with the Seoul International Conference. Finally, the 2018 EYGEC Conference will be held in Graz organized and hosted by the Austrian Member Society.

- AG reported on the activities of the European Regional Technical Committees (ERTCs). The creation and existence of ERTCs is justified if they deal with specific European topics or if it is considered that the subject matter is not adequately covered by an International Technical Committee. Currently there are four ERTCs: ERTC-3: Piles, ERTC-7: Numerical Methods, ERTC-10: Evaluation of Eurocode 7 and ERTC-12: Evaluation of Eurocode 8.

The following remarks were made:

· ERTC-3: Piles. Chair: Maurice Bottiau (Belgium),

This is a very active Committee with a steadily expanding membership. The Committee has held a number of online and face to face meetings. The Committee is currently organizing an International Symposium in Louvain (Leuven), Belgium, in April 2016, devoted to the theme: *Pile design in Europe - How did EC7 changed daily practice?* In addition, DLT guidelines and Design exercises are being prepared. A new open web page is being developed.

· ERTC-7: Numerical Methods. Chair: César Sagaseta (Spain)

The Committee has organized a very successful 8th European Conference on Numerical Methods in Geotechnical Engineering (NUMGE) in Delft on 17-20 June 2014. The next NUMGE Conference will take place in Porto (Portugal) in 2018. The Committee has also organized a workshop just prior to the Edinburgh Conference.

· ERTC-10 Evaluation of Eurocode 7. Chair: Trevor Orr (Ireland).

The main activity for ETC 10 has been the planning and preparation with TC205 and TC 304 of a workshop on *Eurocode 7 and safety and serviceability in geotechnical design* during the Edinburgh Conference

· ERTC-12: Evaluation of Eurocode 8. Chair: Christos Vrettos (Germany)

The main purpose for ETC 12 is to provide general, as well as, specific comments on the EC8 code from the point of view of earthquake geotechnical engineering practice, and in the light of the latest research. Following the untimely death of Professor Michele Maugeri, Professor Christos Vrettos from the Technical University of Kaiserlautern has been appointed chair of the committee. We are grateful to him.

Finally, it should be noted that the ERTC-16 on Education and Training was discontinued because of a general consensus that its activities were better pursued within the TC-306 on "Geo-engineering education".

Concluding, AG stated that he would strongly support any initiative to create new ERTCs provided they enjoyed broad support and were consistent with the ERTC creation criteria indicated above.

4. *National Registration of Ground Engineering Professionals. A European perspective*

AG explained that, when requesting items to include in the Agenda of the meeting, he was contacted by Fintan Buggy (Chairman of the Geotechnical Society of Ireland) suggesting that the meeting of the European member Societies would provide a very appropriate venue to discuss the issue of a National Registration of Ground Engineering Professionals from a European perspective. This European perspective appears to be especially relevant given the Eurocode 7 requirement of "appropriately qualified and experienced personnel" in EN 1997-1:2010 Section 1.3(2). AG asked Fintan Buggy (FB) to get in contact with other Member Societies that were pursuing similar objectives and to prepare a presentation for the meeting.

A 10 minute presentation (Annex 3) was then made by FB introducing the subject, summarising the progress and status of four member societies to date (UK, Germany, Ireland & Sweden) and outlining possible future goals or outcomes for national registration systems dependent upon the degree of coordination between European member societies and possible modification of EN1997.

Andrew Bond, chairman of TC250/SC7 provided information on the present status and plans for modification of the Eurocode. He indicated that any potential changes to improve the definition of the relevant term falls within the remit of CEN Work task WG1/TG2 General Rules who have just been approved to commence work and are due to report with recommendations in 2018. He suggested that some form of mandate from ISSMGE or the European section would be useful to persuade CEN of the need to modify the Eurocode to provide more definition.

M. Korff (Netherlands) and M. Bottiau (Belgium) commented that they had also begun to consider the need for such a registration system. J.S. Steenfelt (Denmark) questioned whether registration would ever result in practice in safer outcomes in terms of geotechnical investigations and designs. G. Franzén (Sweden) stressed that poor communication and understanding between professionals is the main problem and she endorsed the matrix approach pursued by Sweden as the best way to address this problem. M. Bottiau (Belgium) emphasized that Registration is nor merely a question of competence but of recognition as well. N. Smith (UK) shared the valuable experience gained in the implementation of the UK Registration, the most advanced scheme in Europe so far.

At this point AG asked for a show of hands to assess the interest on the issue in the different countries represented in the meeting. About 50-60% hands were raised indicating a quite broad interest. AG proposed that Fintan Buggy coordinated future developments related to this issue and he graciously accepted.

More detailed Minutes of this item of the meeting agenda and subsequent activities that have

taken place will be sent separately to all European Member Societies.

5. *Selection of the European Member Society to organize the next European Conference*

Two bids had been presented to become the hosts of the next European Conference on Soil Mechanics and Geotechnical Engineering to be held in 2019. The venues proposed were Brussels by the Belgian Member Society and Reykjavik by the Iceland Member Society. Information on the two bids had been circulated to the European Member Societies prior to the meeting.

Presentations of the bids lasting about 20 minutes were delivered by Maurice Bottiau from the Belgium Society and by Haraldur Sigursteinsson and Sigurdur Erlingsson from the Iceland Society. After the presentations AG drew the attention of the applicants to the need of ensuring that the papers are properly indexed in the main scientific literature databases. He also reminded them of the ISSMGE policy that the copyright of the papers should remain with the authors so this should be taken into account when negotiating with potential publishers. The representatives of the two bids agreed to act in accordance with these observations.

Voting then took place using the ballot paper shown in Annex 4. The result was:

· Belgium – Brussels: 11 votes

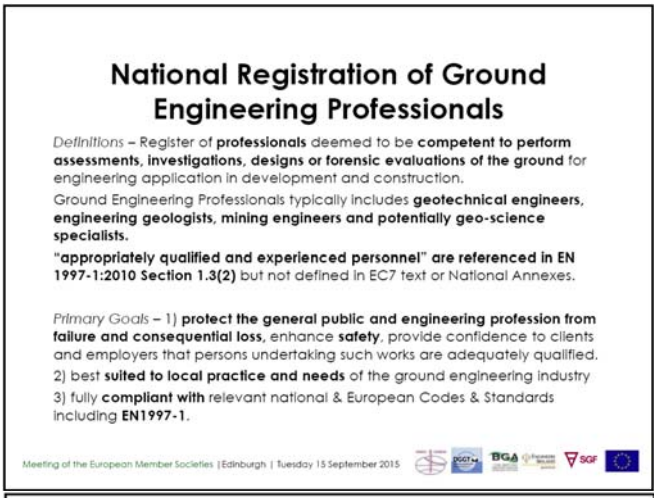
· Iceland – Reykjavik: 22 votes

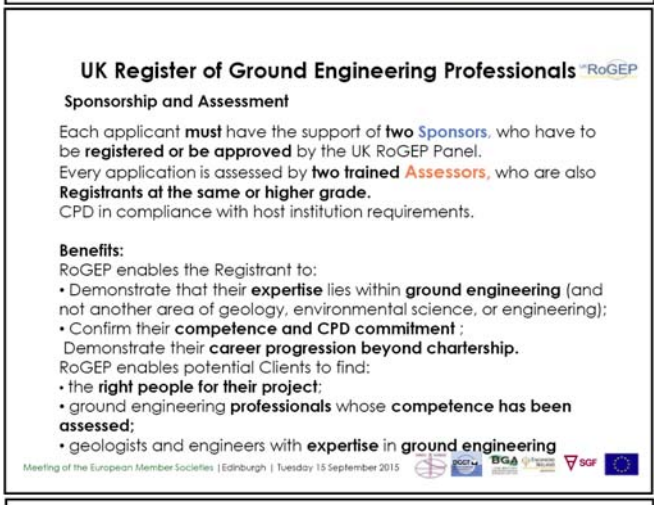
Therefore, **the next ISSMGE European Conference will take place in Reykjavik in 2019** and will be organized by the Icelandic Geotechnical Society.

6. *A.O.B*

There were no further questions raised and AG closed the meeting at 20:15 thanking all participants for a fruitful and rewarding meeting.

Annex 3





German National Ground Engineering Register

- Original reference: "EASV Sachverständige für Geotechnik: Anforderungen an Sachkunde und Erfahrung" – Geotechnik, Vol. 36: p. 51-57, 2013. English translation by Markus Herten, DGGT is available.
- Lack of definition of **"appropriately qualified and experienced personnel" referenced in EN 1997-1:2010 Section 1.3(2);** typically not clarified in National Annexes.
- Detailed Tertiary level education to bachelor or master degree level.
- Minimum **professional experience from 2 to 4 years – Geo Cat 1 / 2 and 5 to 7 years – Geo Cat 3 projects** (varies with academic qualifications). Note that German engineering degrees typically require much longer study duration than in UK / Ireland.
- Competence / experience in a minimum of **3 out of 9 project types plus 3 out of 7 engineering methodologies.**
- Minimum **Continuous Professional Development of 3 days** in specialist areas **over 3 year period** meeting DGGT accreditation criteria.

German National Ground Engineering Register

- DGGT registration requirements are currently (2015) **not legally compulsory in Germany** but informally recommended.
- DGGT is attempting to get **specialist registration legally adopted by Chamber of Engineers "*Ingenieurkammer*" in individual Federal States.** In **Feb 2015** this was being progressed only in the **State of Nordrhein-Westfalen (NRW)** (North Rhine-Westphalia).
- **Specialist registration under Public Law** (e.g. by Chamber of Engineers) considered to be superior to that under Private Law [e.g. by DGGT itself, or by EFG (EurGeol professional title)].
- German registration system has **more specific, quantified entry requirements than UK,** no sponsor is required with an application and is **more focussed on geotechnical consultants role and EN 1997.**
- UK RoGEP has wider appeal to the entire spectrum of geotechnical / engineering geology / mining professionals.
- Need for a unified European registration scheme is desirable and UK / German schemes could serve as a base for such a development.

Irish National Ground Engineering Register

• Existing precedence for specialist Irish registers in areas of Hydrogeologic Assessments for Historic Landfill Sites (2012) and Pyritic Expansive Aggregates in Ireland (2013).

•Joint Working Group formed by members of **Geotechnical Society of Ireland and Institution of Geologists of Ireland since February 2015** with an interim report to Engineers Ireland / IGI in July 2015.

• Joint Working Group contacted a number of key stakeholders from national public & local government agencies plus professional and trade associations in Ireland to solicit opinion. **Broad support for a register from most Employer agencies** but **mixed opinions from within geotechnical engineers / engineering geologists** and **some strong opposition from general engineering consultancy groups.**

• Contact also made with RoGEP in UK to explore potential to join / expand the applicable jurisdiction of the current UK registration system.

Irish National Ground Engineering Register

A draft outline of registration requirements was developed including a stated goal to meeting the requirements of EN 1997.

Draft requirements were a **blend of UK RoGEP and German Geotechnical Society DGGT proposals** (Bock et al 2014) with the following primary characteristics tailored to suit Irish professional needs:

1. Educational and professional qualifications – B. Sc. Degree plus Chartered Engineer / Professional Geologist as a minimum requirement.
2. **Professional experience & Competence – 2 Level System.**
   Professional level, 4 years in specialist area with M. Sc. or 5 years with B. Sc. EN 1997 Geotechnical Cat 1 or 2 (dual application with professional. exam)
   Advisor level 12 years in specialist area with M. Sc. or 15 years with B. Sc. EN 1997 Geotechnical Cat 3.
3. Listing of **specific technical competencies** (22 total - broadly similar to German proposals) with minimum requirements for demonstrated competence **in 8 areas (Professional) or 12 areas (Advisor).**
4. **Continuing Professional Development** – minimum of **5 days** of relevant specialist training **within past 2 years.**
5. Application to be assessed by a specialist panel of geotechnical engineers / engineering geologists appointed by professional bodies. Independent sponsor required to verify experience and competence. No written essay.

Irish National Ground Engineering Register

• Listing and **minimum requirements of specialist competencies has proven the most contentious issue**, especially for **engineering geologists who want the register to be inclusive of a broader area of practice** eg mining, quarrying, contaminated land, hydrogeology sectors.

• UK RoGEP lists around 16 much broader areas of sub-disciplines which are more acceptable to Irish engineering geologists, but not directly related to EN 1997.

• Fundamental disagreement in the goals of the register with **engineering geologists viewing the focus on EN 1997 as being too restrictive** and solely to the benefit of geotechnical engineers. Inclusion of small specialist companies working in niche areas such as geophysics, rock slope stability etc is seen as very important to them.

• Current Working Group recommendation is to **approach UK RoGEP** to discuss easier **access for Irish based specialists** and explore any **potential expansion of the current register to both UK and Ireland** with participation of Engineers Ireland and Institution of Geologists of Ireland. Discussion at next **RoGEP Board Meeting** in **October 2015.**

Swedish National Ground Engineering Register or Swedish Matrix of Competence

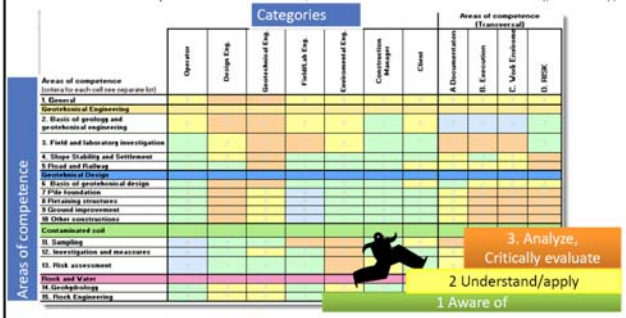
•Main goal to secure the **competence of all professionals in a project** – this is a much broader group than is considered by UK, Germany & Ireland
•Defined competence as: Knowledge + Experience + Education

•Sweden has adapted a **stepwise procedure**
- **Step 1 : Matrix of Competence**
  - Common view of what competence you expect from each professional (Available)
- **Step 2: Matrix of courses**
  - Create the possibility to obtain the competence. (In progress, goal 2016/2017)
- **Step 3: Possible certificate**
  - Possibility in the future, but not the main goal (In future)

- SGF is doing the work together with other ground engineering organisations with in "Knutpunkt Geostandarder" ("Hub Geo Standard")

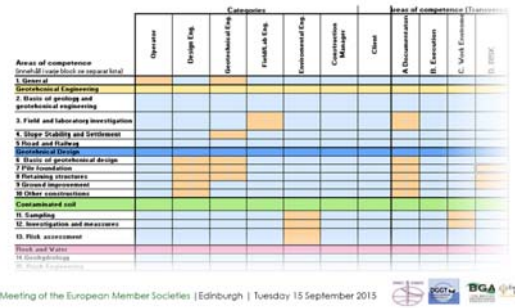
Swedish Matrix of Competence

Matrix of Competence with competence criteria for each box (preliminary)



Swedish Matrix of Courses

Ongoing work – filling each cell with courses/education
Aim: Courses with high quality on a regular basis available for all professionals.



Geosynthetic Institute

The Geosynthetic Institute (GSI) has a long and successful record of promoting geosynthetics research in university engineering programs through is GSI Fellowship Awards program. The 2015 – 2016 Fellowship Awards further extended the reach of eligible candidates, opening for the first time to Master's Degree students too instead of only doctoral candidates.

The outreach was a huge success, broadening the range and number of proposals. A record 21 new proposals were received and 12 recipients were awarded USD $5000 each to begin or continue their research. (GSI allows for renewals on some projects.)

The winners of the 2015 – 2016 Fellowships, as announced by GSI and the GSI Board of Directors, are:

- Melissa Beauragard, University of Colorado "Protocol for Selecting Wall Facing for GS Reinforced Structures." Advisor: Jonathan Wu
- Karl James Bester, University of Cape Town "Test Methods for GT Filters used in Waterway Engineering. " Advisor: Kelvin Legge
- Marton Bredacs, Montan University "Aging Mechanisms and Life Time Assessment of PE Tunnel Liner." Advisor: Gerald Pinter
- Angel Gutierrez, Arizona State University "Evaluation of GM Seam Strain Concentration Factors." Advisor: Edward Kavazanjian
- Muji Huang, NPUST "RECP Soil Protection Properties due to Variables in Channel Flow." Advisor: Wayne Hsieh
- Grace Huang, Virginia Tech "GS Contribution to Stability of Column-Supported Embankments." Advisor: George Filz
- Sadra Javadi, University of Louisville "Advection and Sorption of Organic Containment in GCL with Organo-bentonite." Advisor: Qian Zhao
- Yan Jiang, University of Kansas "Evaluating Performance of Hybrid GRE Walls." Advisor: Jie Han
- Zeru Kiffle, Syracuse University "Finite Element Model of GT Tubes Stacking in Dewatering Projects." Advisor: Shobha Bhatia
- Roland Sievering, RWTH Aachen University "Interaction Modeling in Finite Element Simulation of GG Reinforced Soil." Advisor: Martin Ziegler
- Lei Xu, Columbia University "Centrifuge modeling of wire mesh facing GS reinforced Soil Retaining Wall." Advisor: Hoe Ling
- Shahin Ghazi Zadeh, Colorado State "Evaluation of Long-Term Internal Shear of GCLs in Mining Applications." Advisor: Chris Bareither

The Geosynthetic Institute invites inquiries on the GSI Fellowship Awards program. Contact Jamie Koerner, **jrkoerner@verizon.net**.

Visit **www.geosynthetic-institute.org**.

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ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

ISSMGE is launching its Fifth Webinar of the year!

Dear Colleagues around the Globe,

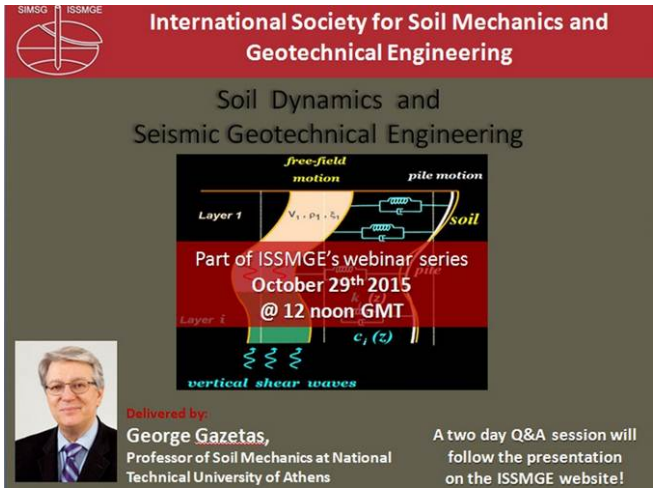
It was a great pleasure meeting some of you at the council meeting in Edinburgh last month. As you know, during that meeting, it was agreed to issue our announcements on the first Monday of each month. However, an exception is being made this time for practical reasons.

In about 2 weeks, the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) with great pleasure will be launching a very nice webinar on a very exciting subject regarding *Soil Dynamics and Seismic Geotechnical Engineering*, given by **Prof. George Gazetas** (from the Technical University of Athens).

All Webinars are Free of Charge in an effort to assist geotechnical engineers worldwide and to promote our profession.

As a Member Society officer receiving this email, action is required from your side as mentioned at the end of this message.

You are welcome to attend and highly encouraged to invite all geotechnical & civil engineers as well as students to do the same. Please distribute this message as soon as possible and as much as you can! This Webinar will be launched on the **29**th day of October 2015 @12 noon GMT. It will be then followed by a 2-day Q&A session that, like the webinar video, can also be viewed anytime later on via our ISSMGE Website.



Hyperlink:
http://www.issmge.org/en/resources/recorded-webinars/782-soil-dynamics-and-seismic-geotechnical-engineering

AS a reminder, you can view all previous webinars published on our website for **FREE**!

With many thanks and best tegards

Dr. Marc Ballouz
ISSMGE Board Member – Liaison to IDC & CAPG & PIC

6th International Conference on Earthquake Geotechnical Engineering, 2-4 November 2015, Christchurch, New Zealand, www.6icege.com

SEOUL 2015 - 25th World Road Congress Roads and Mobility – Creating New Value from Transport, 2–6 November, 2015, Seoul, Republic of Korea, http://www.aipcrseoul2015.org

4ο Πανελλήνιο Συνέδριο Αναστηλώσεων, Νοέμβριος 2015, Θεσσαλονίκη, www.etepam.gr.

The 15th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, 9-13 November 2015, Fukuoka, Japan, http://www.15arc.org

Tunnels and Underground Construction 2015, 11-13 November 2015, Žilina, Slovak Republic, www.tps2015.sk

15th Pan-American Conference on Soil Mechanics and Geotechnical Engineering, 15 - 18 November 2015, Buenos Aires, Argentina, http://conferencesba2015.com.ar

GEOMATE, 16 -18 November 2015, Osaka, Japan, www.geomate.org

VIII South American Congress on Rocks Mechanics, 15 - 18 November 2015, Buenos Aires, Argentina, http://conferencesba2015.com.ar

Sixth International Conference on Deformation Characteristics of Geomaterials IS Buenos Aires 2015, November 15th to 18th 2015, www.saig.org.ar/ISDCG2015

Waterproof Membranes 2015, 17 - 19 November 2015, Bonn, Germany, www.amiplastics.com/events/event?Code=C691#5155

JTC-1 TR3 Forum Slope Safety Preparedness for Effects of Climate Change, 18 and 19 November 2015 Naples, Italy, www.cmcc.it/events/workshop-slope-safety-preparedness-for-effects-of-climate-changes

GeoME 2015 - 7th International Conference GEOSYNTHETICS Middle East, 16 & 17 November 2015, Abu Dhabi, UAE, www.geosyntheticsme.com

Slope Engineering and Geotechnical Asset Management Conference 2015, 18-19 November 2015, London, United Kingdom, slopes.geplus.co.uk

TBM DiGs Tunnel Boring Machines in Difficult Grounds, 18-20 November 2015, Singapore, www.tbmdigs.org

Arabian Tunnelling Conference & Exhibition: Innovative Underground Infrastructure - And Opportunities, 23-25 November 2015, Dubai, UAE, www.atcita.com

Geo-Environment and Construction, 26-28 November 2015, Tirana, Albania, Prof. Dr. Luljeta Bozo, lulibozo@gmail.com; luljeta_bozo@universitetipolis.edu.al

ICSGE 2015 - The International Conference on Soft Ground Engineering, 3-4 December 2015, Singapore, www.geoss.sg/icsge2015

The 1st International Conference on Geo-Energy and Geo-Environment (GeGe2015) 4th and 5th December 2015, Hong Kong, http://gege2015.ust.hk

2015 6th International Conference Recent Advances in Geotechnical Engineering and Soil Dynamics, December 7-11, 2015, New Delhi (NCR), India, wason2009@gmail.com; wasonfeq@iitr.ernet.in, sharmamukat@gmail.com; mukutfeq@iitr.ernet.in, gvramanaiitdelhi@gmail.com, ajaycbri@gmail.com

Southern African Rock Engineering Symposium an ISRM Regional Symposium, 5 January 2016, Cape Town, South Africa, http://10times.com/southern-african-rock

Environmental Connection Conference, February 16–19, 2016, San Antonio, Texas, USA, www.ieca.org/conference/annual/ec.asp

ASIA 2016 - Sixth International Conference on Water Resources and Hydropower Development in Asia, 1-3 March 2016, Vientiane, Lao PDR, www.hydropower-dams.com/pdfs/asia20161.pdf

GeoAmericas 2016 3rd Panamerican Conference on Geosynthetics, 11 – 14 April 2016, Miami Beach, USA, www.geoamericas2016.org

International Symposium on Submerged Floating Tunnels and Underwater Structures (SUFTUS-2016), 20-22 April 2016, Chongqing, China, www.cmct.cn/suftus

World Tunnel Congress 2016 "Uniting the Industry", April 22-28, 2016, San Francisco, USA, http://www.wtc2016.us

International Symposium "Design of piles in Europe - How did EC7 change daily practice?", 28-29 April 2016, Leuven, Belgium, www.etc3.be/symposium2016

7th In-Situ Rock Stress Symposium 2016 - An ISRM Specialised Conference, 10-12 May 2016, Tampere, Finland, www.rs2016.org

84th ICOLD Annual Meeting, 16-20 May 2016, Johannesburg, South Africa, www.icold2016.org

2nd International Conference on Rock Dynamics and Applications (RocDyn-2), 18 – 20 May 2016, Suzhou, China http://rocdyn.org

13th International Conference Underground Construction Prague 2016 and 3rd Eastern European Tunnelling Conference (EETC 2016), 23 to 25 May 2016, Prague, Czech Republic, www.ucprague.com

GEOSAFE: 1st International Symposium on Reducing Risks in Site Investigation, Modelling and Construction for Rock Engineering - an ISRM Specialized Conference, 25 – 27 May 2016, Xi'an, China, www.geosafe2016.org/dct/page/1

14th International Conference of the Geological Society of Greece, 25-27 May, Thessaloniki, Greece, www.ege2016.gr

NGM 2016 - The Nordic Geotechnical Meeting, 25 - 28 May 2016, Reykjavik, Iceland, www.ngm2016.com

International Mini Symposium Chubu (IMS-Chubu) New concepts and new developments in soil mechanics and geotechnical engineering, 26 - 28 May 2016, Nagoya, Aichi, Japan, www.jiban.or.jp/index.php?option=com_content&view=article&id=1737:2016052628&catid=16:2008-09-10-05-02-09&Itemid

19SEAGC – 2AGSSEAC Young Geotechnical Engineers Conference, 30th May 2016, Petaling Jaya, Selangor, Malaysia, seagc2016@gmail.com

19th Southeast Asian Geotechnical Conference & 2nd AGSSEA Conference Deep Excavation and Ground Improvement, 31 May – 3 June 2016, Subang Jaya, Malaysia, seagc2016@gmail.com

ISSMGE TC211 Conference Session within the framework of the 19th Southeast Asian Geotechnical Conference "GROUND IMPROVEMENT works: Recent advances in R&D, design and QC/QA"

ISL 2016 12th International Symposium on Landslides Experience, Theory, Practice, Napoli, June 12th-19th, 2016, www.isl2016.it

4th GeoChina International Conference Sustainable Civil Infrastructures: Innovative Technologies for Severe Weathers and Climate Changes, July 25-27, 2016, Shandong, China, http://geochina2016.geoconf.org

6th International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics August 1-6, 2016, Greater Noida (NCR), India, www.6icraqee.com

EUROC 2016 - ISRM European Regional Symposium Rock Mechanics & Rock Engineering: From Past to the Future, 29-31 August 2016, Ürgüp-Nevşehir, Cappadocia, Turkey http://eurock2016.org

3rd ICTG – 3rd International Conference on Transportation Geotechnics 4 - 7 September 2016, Guimaraes, Portugal, www.civil.uminho.pt/3rd-ICTG2016

IAS'5 5th International Conference on Geotechnical and Geophysical Site Characterisation, 5-9 September 2016, Gold Coast, Queensland, Australia http://www.isc5.com.au

SAHC 2016 - 10th international Conference on Structural Analysis of Historical Constructions 13-15 September 2016, Leuven, Belgium, www.sahc2016.be

13 Baltic States Geotechnical Conference Historical Experiences and Challenges of Geotechnical Problems in Baltic Sea Region, 15 - 17 September 2016, Vilnius, Lithuania, http://www.13bsgc.lt

EuroGeo 6 – European Regional Conference on Geosynthetics, 25 – 29 Sep 2016, Istanbul, Turkey, www.eurogeo6.org

2nd International Specialized Conference on Soft Rocks
29-30 September 2016, Cartagena, Colombia

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E-mail: sociedadcolombianadegeotecnia@scg.org.co

ARMS 9, 9th Asian Rock Mechanics Symposium, ISRM Regional Symposium, 18-20 October 2016, Bali, Indonesia, http://arms9.com

GeoAsia 6 - 6th Asian Regional Conference on Geosynthetics 8-11 November 2016, New Delhi, India, http://seags.ait.asia/news-announcements/11704

RARE 2016 Recent Advances in Rock Engineering 16-18 November 2016, Bangalore, India, www.rare2016.in

AfriRock 2017, 1st African Regional Rock Mechanics Symposium, 12 – 17 February 2017, Cape Town, South Africa, www.saimm.co.za/saimm-events/upcoming-events

World Tunnel Congress 2017
Surface problems – Underground solutions
9 to 16 June 2017, Bergen, Norway
www.wtc2017.no

"Surface problems – Underground solutions" is more than a slogan; for ITA-AITES and its members it is a challenge and commitment to contribute to sustainable development. The challenges are numerous and the availability of space for necessary infrastructure ends up being the key to good solutions. The underground is at present only marginally utilized. The potential for extended and improved utilization is enormous.

EUROCK 2017
13-15 June 2017, Ostrava, Czech Republic

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708 00 Ostrava-Poruba
Czech Republic
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Fax: + 420 596 919 452
E-mail: petr.konicek@ugn.cas.cz

19th International Conference on Soil Mechanics and Geotechnical Engineering, 17 - 22 September 2017, Seoul, Korea, www.icsmge2017.org

GeoAfrica 2017
3rd African Regional Conference on Geosynthetics
9 – 13 October 2017, Morocco

11th International Conference on Geosynthetics (11ICG)
16 - 20 Sep 2018, Seoul South Korea
csyoo@skku.edu

10th Asian Rock mechanics Symposium - ARMS10
October 2018, Singapore

Prof. Yingxin Zhou
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SINGAPORE 189022
Telephone: (+65) 637 65363
Fax: (+65) 627 35754
E-mail: zyingxin@dsta.gov.sg

AFTES International Congress
"The value is Underground"
13-16 November 2017, Paris, France

World Tunnel Congress 2018
20-26 April 2018, Dubai, United Arab Emirates

14th ISRM International Congress
2019, Foz de Iguaçu, Brazil

Contact Person: Prof. Sergio A. B. da Fontoura
E-mail: fontoura@puc-rio.b

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Massive rock threatening to crash into base of Arizona dam

Workers stabilizing a sandstone wall along the Glen Canyon dam near Page, Ariz.

A massive piece of rock is at risk of crashing down from a canyon wall to the base of an Arizona dam, prompting the government to send in a crew of rappelers to keep the slab in place.

The 500,000-pound slab — weighing more than many jumbo jets — began to break away from the canyon wall last week in what the U.S. Bureau of Reclamation attributes to erosion that is typical for that type of rock. The area below the slab includes a passageway to a boat ramp, a machine shop and water and power facilities for the dam.

The Bureau of Reclamation has cut off access to the boat ramp, putting some rafting trips on hold until the rock can be secured.

A three-person crew has been scaling the towering walls to drill bolts that range from 6 feet to 8 feet into the sandstone. Six bolts were placed in the canyon wall a week ago before a small chunk broke loose and crashed to the ground, hitting a building and leaving a pile of rubble, said Bureau of Reclamation spokesman Chris Watt.

"It's just plain luck that it didn't cause more damage because we don't know how big of chunks are going to fall," he said. "If more of it falls, that's a real concern."

The slab measures 30 feet at its widest point and is 50 feet tall. Its thickness ranges from six inches to 4 feet, he said.

The plan is to attach bolts in the area above the crack to make sure it's safe enough for crews to then work on the slab that is in jeopardy of falling. Temperatures can top 110 degrees on the face of the wall, limiting the hours the crew can work, Watt said. The work isn't expected to be complete until the first week of October.

The slab is about 150 feet away from the edge of the dam, which is not in danger of being hit by the rock. Watt also said the location is at constant risk of falling rock, and engineers have constructed protections at the site such as stronger buildings and an area designed to catch falling rock.

For now, a rafting company that takes tourists from the base of the dam down the Colorado River to Lees Ferry has cut down on the number of daily trips. Colorado River Discovery general manager Korey Seyler said the company is now launching at Lees Ferry, about 15 miles downstream, and traveling up the river until it gets the OK to resume normal operations.

"It certainly has had a major impact on us, as all of our trips depart from the base of the dam," he said. "We've ceased having the ability to access the area."

Rock falls aren't uncommon at Glen Canyon. The layer of rock known as Navajo sandstone is common in the Southwest, particularly in Utah, and is prone to cracks due to erosion.

This crack is the largest one in years, and workers at the dam have been watching it closely, Watt said.

Frank Talbott, a former river guide who lives just outside Page, said rocks have fallen into the river and taken out part of a catwalk that goes to the lower part of the dam.

"They just happen, and it doesn't hurt anything, unless it's right at a special place at the dam," he said.

(Felicia Fonseca / Associated Press, http://www.msn.com/en-us/news/us/massive-rock-threatening-to-crash-into-base-of-arizona-dam/ar-AAdWQB1?ocid=se)

Qatar Rail TBMs entered into Guinness Records

Qatar Rail has been officially recognised by the Guinness World Records for "The Largest Number of Tunnel Boring Machines Operating Simultaneously in a Single Project", marking a milestone for large-scale transport projects in Qatar and across the region.

Since their launch, works for Qatar Rail's mega projects have been progressing at full speed thanks to cutting edge technologies from leading manufacturers and suppliers and a strong focus on operational efficiency.

Deployed across the works for the Doha Metro stations, Qatar Rail's 21 advanced tunnel boring machines (TBM) have achieved many breakthrough milestones for the project's overall progress.

Qatar Rail's Managing Director, Eng. Abdulla Abdulaziz Al Subaie said: "Since we embarked on this journey, we've committed ourselves, our resources, our partners and our technologies to delivering world-class projects with speed and efficiency. This recognition by the Guinness World Records is a hard-earned and well-deserved testament to the collective power of our teams, our partners and our stakeholders, who never lost sight of what is needed to deliver our ambitious plans. This certificate is only a chapter in our story. I am confident in that Qatar Rail will be seeing more record-setting achievements in the future."

Eng. Saad Ahmed Al Muhannadi, Qatar Rail's CEO concurred: "With a Guinness book recognition under our belt, we carry an even greater and larger responsibility towards our community in successfully closing the tunnelling phase for the Doha Metro project. Qatar Rail is keen on meeting and outperforming on its ambitious objectives and world-class benchmarks. We dedicate this achievement – that is a clear indication of the scale and importance of the Doha Metro project - to our team, as well as to the State of Qatar and all our stakeholders who have shared our vision and ambition".

This record for Qatar Rail has broken the previous world record which had set an initial benchmark of 19 simultaneously operational TBMs.

Qatar Rail's management team receiving the Guinness Book certificate at the company's headquarters in Doha.

The certification process for Qatar Rail entailed a stringent verification process undertaken by the Guinness World Records Authority, which included a verification committee of 20 inspectors appointed for every operational TBM. Each machine was filmed in action.

Qatar Rail also had to supply the Geographic Information System (GIS) data to the inspectors which confirmed works and status of all TBMs.

Validating the results has been undertaken by Professor Arnold Dix, an independent record verifier and a highly accomplished tunneling expert and lawyer who heads a legal chapter in the International Tunneling Association (ITA), and whose credentials were accepted by the Guinness committee.

Currently, Qatar Rail manages the operations of 21 TBMs working underground as part of the Doha Metro project. The high tech machines imported from Germany, are set to accomplish the tunnelling phase in 2017, while the first stage of the Doha Metro project will be delivered later in 2019.

(Kim Kemp / Construction Week Online.com, Sep 27, 2015, http://www.constructionweekonline.com/article-35521-qatar-rail-tbms-entered-into-guinness-records)

The Lake That Was Born From An Earthquake

In 1911 a local earthquake caused a large landslide which blocked the Murghab River. The valley is relatively new on the geological scale which means that it is deep and narrow and has steep slopes. That is why this landslide was enough to form the extremely high Usoi Dam (approximately 550 m) - the highest in the world, natural or artificial.

Despite the tempting turquoise waters, the story behind this beautiful lake is worrying. The Sarez Lake in Tajikistan is in the depths of the Pamir Mountains.

The length of the Usoi Dam is about 500 meters which is almost equal to its height. However, the lakes formed by landslides are not uncommon in the Pamir or anywhere else in the world.

The lake is located 3,263 m above the sea level, and it puts millions of people in Tajikistan, Afghanistan, and Uzbekistan living below the Sarez Lake and along the banks of rivers Mugrab, Panj and Amu Darya into jeopardy. The Usoi Dam is solid enough to resist corrosion and create such a big lake, but it is doubtful if it can withstand a major earthquake, which is not unusual in the area. Not only can an earthquake destabilizes the Usoi Dam directly, but it can cause a landslide which could result in a tsunami and lead to the overflow of the dam.

(Written by Geoengineer.org, 14 September 2015)

The Sarez-Pamir Earthquake and Landslide of 18 February 1911

Nicholas Ambraseys[+] and Roger Bilham

INTRODUCTION

A hundred years ago 2.4 cubic km of rock fell from a Pamir mountainside >700 m to the valley floor, releasing potential energy equivalent to an *Mw* 7.8 ± 0.1 earthquake. Its fall created the world's highest dam, impounding a 17-km3 lake that remains to this day. Seismograms recorded in Europe and Asia registered an earthquake at the approximate time of the fall, and soon after the details of the landslide had been evaluated a controversy arose concerning whether these seismograms had recorded an earthquake that had triggered the landslide, or whether the seismograms had merely registered waves generated by the potential energy release of the landslide's impact. Boris Galitzin (1915) reasoned that the radiated energy almost exactly equaled the potential energy released by the fall, and hence represented the unique case of the hypocenter and the epicenter being identical. Otto Klotz (1916) translated Galitzin's article with a preface underlining its importance, and Harold Jeffreys, in a 1923 article, despite revealing flaws in Galitzin's calculations, confirmed both the approximate coincidence in location of the two events and the equality of energy release computed by Galitzin. However, that same year Richard

Oldham dismissed the implications of Jeffreys's calculations, noting that the maximum epicentral damage was offset from the landslide and that the area of felt shaking was typical of a deep earthquake. Though Oldham's arguments were eventually to win, it would take another decade before it was realized that it was the long duration of energy release in the landslide that accounted for its apparent absence in distant seismograms. The details of the causal earthquake, and the curious equality in landslide and earthquake energy, have never been fully resolved. We attempt to do so in this article. We quantify what is known of the earthquake and trace the history of exploration and analysis of the landslide, whose effects remain a threat to Pamir populations to this day.

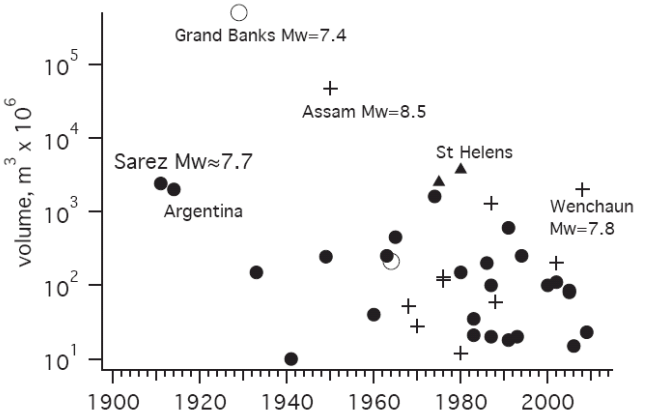


Figure 1. Significant landslides since 1900. Open circles indicate submarine slides, and triangles are volcanic flank collapse events. Cumulative volumes from multiple earthquake-induced slides are indicated by crosses (after Keefer 1984).

The landslide blocked the Murghab River at Usoy, impounding the 60-km-long, 550-m-deep Lake Sarez, named after the town it flooded a year after the collapse. The level of Lake Sarez currently hovers approximately 40 m below the summit of the Usoy landslide, in approximate equilibrium between river discharge and leakage through the porous upper part of the debris pile. The level of the lake fluctuates seasonally, but a decrease in permeability has resulted in a mean rate of rise of 18.5 cm/yr in the past five decades. The future stability of the dam is a concern (Alford and Schuster 2000a, 2000b) but is not discussed here. We first place the volume of the landslide in context. The volume of the Usoy slide is the largest single landslide in the world to have occurred in the past century (Figure 1). It was accompanied by numerous smaller landslides with an unknown total volume. These subsidiary landslides occurred largely within an area we identify as Intensity VI (MSK) in Figure 2, with the most prominent slides occurring within the zone of Intensity VII. The area affected by triggered landslides in mountainous regions is approximately proportional to earthquake magnitude (Keefer 1984). For example, the 1950 Assam earthquake (*Mw* = 8.5) resulted in a 47-km3 surge of sediments downstream in the following several decades (Kingdon-Ward 1953; Goodbred *et al.* 2002). The 2008 Wenchuan earthquake (*Mw* = 7.9) launched ≈150,000 slides, which dammed >100 rivers with a cumulative landslide volume of 5–15 km3 (Wang 2008; Huang and Li 2009; Parker *et al.* 2011). In the years following the 1911 Pamir earthquake, landslides were mapped between Pasor and Irkht and along the length of Lake Sarez, consistent with the ≈50-km radius for landslide activation anticipated from an *Mw* ≈ 7.5 earthquake (Keefer and Wilson 1989). Access routes were inadequate to provide a thorough survey of the zone affected by minor landslides.

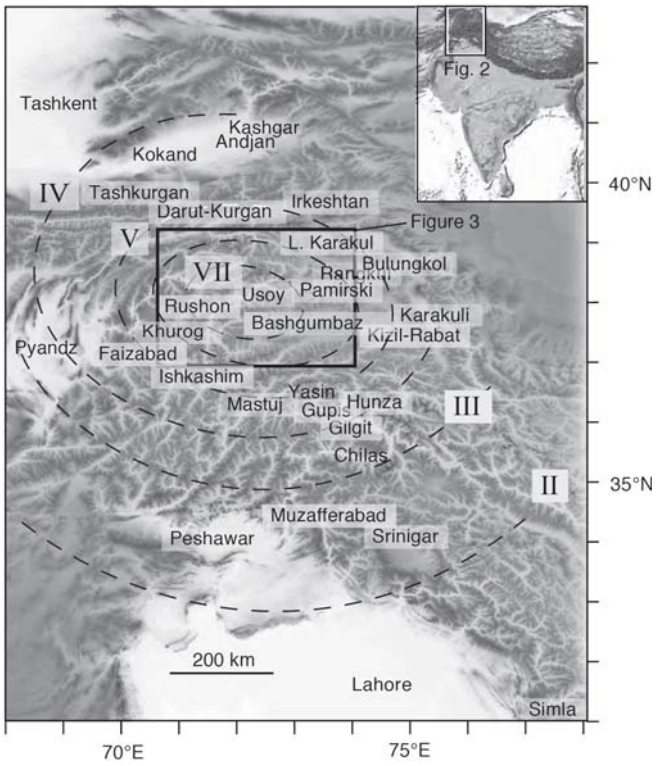


Figure 2. Pamir and surroundings with locations discussed in text. Isoseismal contours (MSK) dashed.

We relate the history of the several official and private expeditions to the central Pamir that were responsible for investigating the evidence for the epicentral damage. Then we attempt to locate and assign a magnitude to the earthquake from these data and to place the earthquake in the context of what we now know of the tectonics of the northern Pamir range.

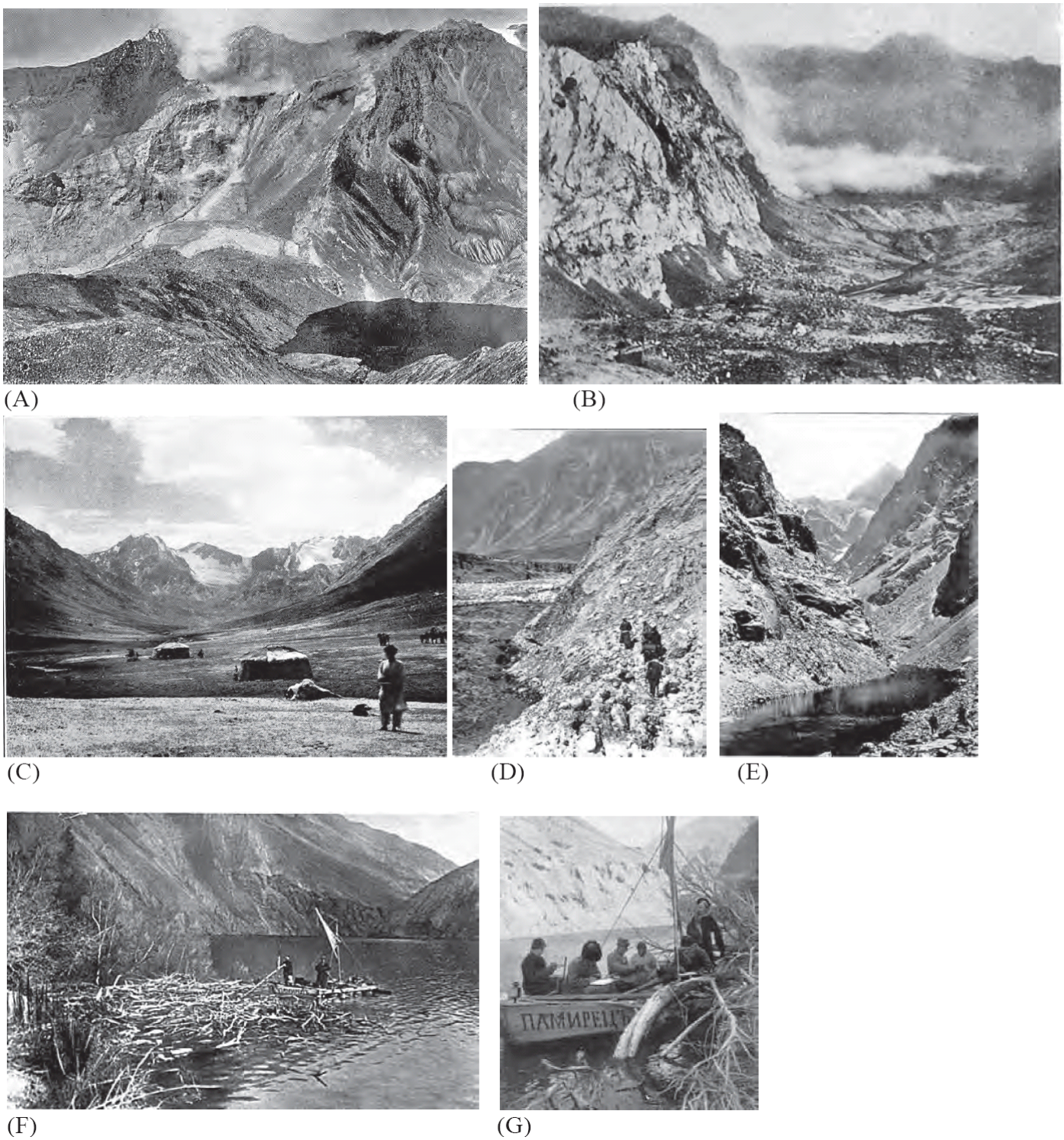


Figure 3. Photo montage of contemporary photographs of the Usoy landslide and its approaches and maps by Shpilko (1914, 1915), Stein (1928), and Chuenko (1936). (A) The natural dam of Usoy thrown across the Bartang River. In the background is the scarp left after the collapse of the south face of the mountain. Clouds of dust raised by rock falls were seen on higher slopes in August 1915. The crest of the dam is on the left in the foreground, with the western end of Lake Sarez on the right (Stein 1933, Plate 373). (B) One of the rockslides followed by ice flow (Preobrazhenski 1915). (C) Kirghiz camp near the head of Bashgumbaz Valley in 1913 (Stein 1933, Plate 379). (D) Center: Crossing debris thrown down by the earthquake near Palaz in the Tanimz Valley in 1915 (Stein 1933, Plate 369). (E) The gorge of Bartang River blocked above Raut by the earthquake. A newly formed tarn can be seen in the foreground; the former riverbed was buried under rock debris in 1915 (Stein 1933, Plate 371). (F) Shpilko's expedition surveying in a homemade boat in Lake Sarez in 1913 (CECD 2007). (G) Shpilko's surveying boat in Lake Sarez in 1913 (CECD 2007; Stein 1933 Plate 371).

(Seismological Research Letters Volume 83, Number 2
March/April 2012, pp. 294-314)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Οι πιο ισχυροί μεταξύ Απριλίου – Οκτωβρίου
Οι σεισμοί φαίνεται να επηρεάζονται από τις εποχές του έτους

Για κάποιον λόγο που οι επιστήμονες δεν έχουν ακόμη ανακαλύψει, οι πιο ισχυροί και με μεγαλύτερο εστιακό βάθος σεισμοί φαίνεται να επηρεάζονται από την εποχή του έτους, καθώς γίνονται συνήθως μεταξύ Απριλίου-Οκτωβρίου.

Τα ευρήματα

Ερευνητές στις ΗΠΑ, με επικεφαλής τον **Ζονγκγουέν Ζαν** του Ινστιτούτου Τεχνολογίας της Καλιφόρνια (Caltech) και τον **Πίτερ Σίρερ** του Ινστιτούτου Ωκεανογραφίας Scripps μελέτησαν όλους τους σεισμούς που συνέβησαν στη Γη μετά το 1900.

Από τους συνολικά 60 μεγάλους (άνω των 7 βαθμών) και βαθιούς σεισμούς (σε βάθος κάτω των 500 χιλιομέτρων), οι περισσότεροι (42) συνέβησαν την περίοδο Απριλίου-Οκτωβρίου. Ανάλογο εποχικό πρότυπο δεν φαίνεται να υπάρχει στους μικρότερους και πιο ρηχούς σεισμούς. Προφανής εξήγηση δεν υπάρχει. «Από φυσική σκοπιά, η εποχικότητα δεν έχει νόημα» δήλωσε ο Ζαν.

Μια πιθανή αιτία είναι οι δυνάμεις που δέχεται ο πλανήτης από τη βαρύτητα του Ήλιου ή λόγω της περιστροφής γύρω από τον άξονά του και οι οποίες μπορεί να αυξομειώνονται ανάλογα με την εποχή του έτους. Όμως αυτές οι δυνάμεις είναι μικρές σε σχέση με τη βαρυτική επίδραση της Σελήνης πάνω στη Γη.

Από την άλλη, σε βάθη 500 έως 700 χιλιομέτρων οι θερμοκρασίες και οι πιέσεις είναι τόσο μεγάλες, που τα πετρώματα θα έπρεπε να είναι τόσο μαλακά, ώστε δεν θα ήταν καν πιθανό να υφίστανται ξαφνικά ρήγματα και να προκαλούνται σεισμοί.

Παλιά ιδέα

Η εποχική τάση στους σεισμούς είχε προταθεί για πρώτη φορά στη δεκαετία του '30. Τις επόμενες δεκαετίες όμως, νέα στοιχεία και στατιστικά δεδομένα που ήλθαν στο φως, φάνηκε να αναιρούν τον ισχυρισμό αυτό. Η νέα μελέτη επαναφέρει το ζήτημα της εποχικότητας, αλλά δεν έχουν πειστεί όλοι επιστήμονες περί αυτού.

Σύμφωνα με τη νέα ανάλυση, η εποχικότητα είναι πολύ πιο ορατή σε μερικές περιοχές από ό,τι σε άλλες. Έτσι, π.χ. στη σεισμογενή Ιαπωνία σχεδόν όλοι οι ισχυροί και βαθιοί σεισμοί συμβαίνουν μεταξύ Απριλίου και Οκτωβρίου. Η μελέτη δημοσιεύεται στην επιθεώρηση «Geophysical Research Letters».

(Newsroom ΔΟΛ, με πληροφορίες από ΑΠΕ-ΜΠΕ /25 Σεπ. 2015, http://news.in.gr/science-technology/article/?aid=1500028243)

Possible seasonality in large deep-focus earthquakes

Zhongwen Zhan and Peter M. Shearer

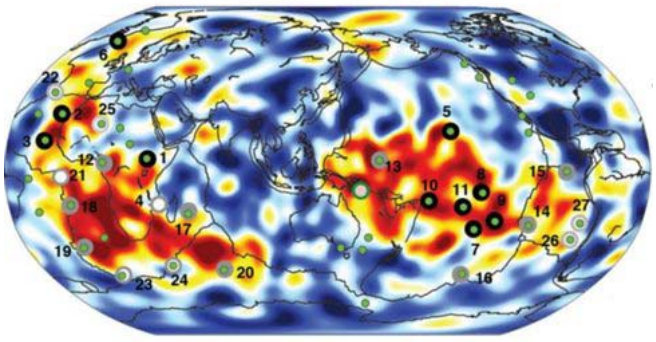
Abstract

Large deep-focus earthquakes (magnitude > 7.0, depth > 500 km) have exhibited strong seasonality in their occurrence times since the beginning of global earthquake catalogs. Of 60 such events from 1900 to the present, 42 have occurred in the middle half of each year. The seasonality appears strongest in the northwest Pacific subduction zones and weakest in the Tonga region. Taken at face value, the surplus of northern hemisphere summer events is statistically significant, but due to the ex post facto hypothesis testing, the absence of seasonality in smaller deep earthquakes, and the lack of a known physical triggering mechanism, we cannot rule out that the observed seasonality is just random chance. However, we can make a testable prediction of seasonality in future large deep-focus earthquakes, which, given likely earthquake occurrence rates, should be verified or falsified within a few decades. If confirmed, deep earthquake seasonality would challenge our current understanding of deep earthquakes.

(Geophysical Research Letters / AGU Publications, 16 September 2015, http://onlinelibrary.wiley.com/doi/10.1002/2015GL065088/full)

Οι στήλες του μανδύα
Παγκόσμια αξονική τομογραφία δείχνει τη Γη να κοχλάζει

Ένας τρισδιάστατος χάρτης του γήινου μανδύα, ο οποίος δημιουργήθηκε με προσομοιώσεις και ανάλυση σεισμικών δεδομένων, επιβεβαιώνει την κρατούσα θεωρία για τις στήλες καυτού βράχου που αναβλύζουν από βάθος 2.900 χιλιομέτρων και συχνά γεννούν ηφαίστεια στην επιφάνεια.



Το υπολογιστικό μοντέλο δείχνει δεκάδες στήλες καυτών πετρωμάτων να αναβλύζουν από τη βάση του μανδύα (Πηγή: University of California - Berkeley)

Το εσωτερικό της Γης μοιάζει με κρεμμύδι: ο εξωτερικός φλοιός, ο οποίος περιέχει τους ωκεανούς και τις ηπείρους, καλύπτει έναν παχύ μανδύα από θερμό αλλά στέρεο βράχο.

Κάτω από τον μανδύα βρίσκεται ο εξώτερος πυρήνας, αποτελούμενος από λιωμένο σίδηρο και νικέλιο, κάτω από τον οποίο κρύβεται ο εσώτερος μανδύας, μια γιγάντια σφαίρα από συμπαγή σίδηρο.

Η θερμότητα του πυρήνα αναγκάζει τα πετρώματα του μανδύα να ανεβαίνουν μέχρι τον φλοιό όπου ψύχονται και αρχίζουν να ξαναπέφτουν προς το κέντρο -το ίδιο συμβαίνει για παράδειγμα με το νερό που θερμαίνεται στη βάση μιας κατσαρόλας.

Το 1971, ο αμερικανός γεωφυσικός Τζέισον Μόργκαν πρότεινε τη θεωρία ότι οι τεκτονικές πλάκες του φλοιού επιπλέουν πάνω από στατικές, ανοδικές στήλες καυτού βράχου, οι οποίες αναβλύζουν από το όριο ανάμεσα στον μανδύα και τον φλοιό. Σε αντίθεση με τις τεκτονικές πλάκες που διαρ-κώς μετακινούνται, αυτές οι στήλες, γνωστές και ως λοφία, παραμένουν στη θέση τους για εκατομμύρια χρόνια.

Σε ορισμένες περιπτώσεις, τα λοφία διαπερνούν τον υπερκείμενο φλοιό που κινείται και δημιουργούν έτσι αλυσίδες ηφαιστειακών νησιών όπως το αρχιπέλαγος της Χαβάης.

Μέχρι σήμερα, επισημαίνουν οι συντάκτες της νέας μελέτης, οι ενδείξεις για την ύπαρξη αυτών των στηλών παρέμεναν ανεπαρκείς.

Η νέα έρευνα, η οποία δημοσιεύεται στο περιοδικό Nature (http://www.nature.com/nature/journal/v525/n7567/full/nature14876.html), δείχνει τώρα να επιβεβαιώνει τη θεωρία. Οι ερευνητές του Πανεπιστημίου της Καλιφόρνια στο Μπέρκλεϊ ανέλυσαν την πορεία των σεισμικών κυμάτων από 273 ισχυρούς σεισμούς την τελευταία εικοσαετία. Η ταχύτητα και η πορεία των κυμάτων αυτών επηρεάζεται από μεταβολές της πυκνότητας, επιτρέποντας στους ερευνητές να υπολογίσουν τη δομή ολόκληρου του μανδύα.

Το υπολογιστικό μοντέλο που προέκυψε δείχνει δεκάδες λοφία καυτού βράχου να κοχλάζουν κάτω από τον φλοιό. «Μέχρι σήμερα κανείς δεν είχε δει αυτά τα κιονοειδή αντικείμενα που συνεχίζονται από τη βάση του μανδύα μέχρι το ανώτερο τμήμα του» υπερηφανεύεται ο Σκοτ Φρεντς, πρώτος συγγραφέας της δημοσίευσης.

Το εντυπωσιακό είναι πως όλα τα λοφία δείχνουν να πηγάζουν από δύο θερμές περιοχές στη βάση του μανδύα, διαμέτρου 5.000 χιλιομέτρων η καθεμία, οι οποίες βρίσκονται σε αντιδιαμετρικές θέσεις κάτω από την Αφρική και τον Ειρηνικό.

Σε βάθος 1.000 χιλιομέτρων από την επιφάνεια, τα λοφία έχουν διάμετρο 600 έως 1.000 χιλιόμετρα. Πάνω από αυτό το βάθος αρχίζουν να απλώνονται σαν τα δέλτα των ποταμών. Σε αυτές της περιοχές του φλοιού υπάρχουν συχνά ηφαίστεια, έστω κι αν δεν βρίσκονται ακριβώς πάνω από το λοφίο.

Τα λοφία είναι τουλάχιστον 400 βαθμούς Κελσίου πιο θερμά από τον υπόλοιπο μανδύα και πιθανότατα έχουν ελαφρώς διαφορετική χημική σύσταση, κάτι που αποτυπώνεται και στη σύσταση των ηφαιστείων πάνω από τα λοφία.

Τα λοφία εκτιμάται ότι παραμένουν ενεργά και στάσιμα για πολλά εκατομμύρια χρόνια. Το εντυπωσιακό όμως είναι ότι οι δύο γιγάντιες θερμές περιοχές από όπου αναβλύζουν τα λοφία εκτιμάται ότι παραμένουν στη θέση τους, κάτω από την Αφρική και τον Ειρηνικό, εδώ και 250 εκατομμύρια χρόνια.

(Βαγγέλης Πρατικάκης / Newsroom ΔΟΛ, 07 Σεπ. 2015, http://news.in.gr/science-technology/article/?aid=1500023724)

Broad plumes rooted at the base of the Earth's mantle beneath major hotspots

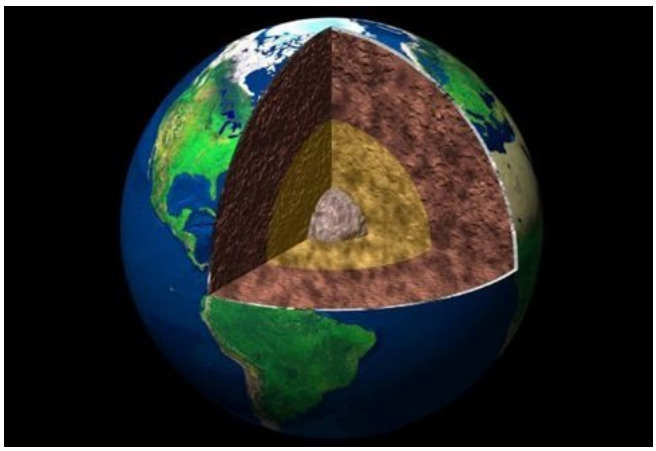
Scott W. French & Barbara Romanowicz

Nature, **525**, 95–99 (03 September 2015), doi:10.1038/nature14876

Plumes of hot upwelling rock rooted in the deep mantle have been proposed as a possible origin of hotspot volcanoes, but this idea is the subject of vigorous debate. On the basis of geodynamic computations, plumes of purely thermal origin should comprise thin tails, only several hundred kilometres wide[3], and be difficult to detect using standard seismic tomography techniques. Here we describe the use of a whole-mantle seismic imaging technique—combining accurate wavefield computations with information contained in whole seismic waveforms—that reveals the presence of broad (not thin), quasi-vertical conduits beneath many prominent hotspots. These conduits extend from the core–mantle boundary to about 1,000 kilometres below Earth's surface, where some are deflected horizontally, as though entrained into more vigorous upper-mantle circulation. At the base of the mantle, these conduits are rooted in patches of greatly reduced shear velocity that, in the case of Hawaii, Iceland and Samoa, correspond to the locations of known large ultralow-velocity zones. This correspondence clearly establishes a continuous connection between such zones and mantle plumes. We also show that the imaged conduits are robustly broader than classical thermal plume tails, suggesting that they are long-lived, and may have a thermochemical origin. Their vertical orientation suggests very sluggish background circulation below depths of 1,000 kilometres. Our results should provide constraints on studies of viscosity layering of Earth's mantle and guide further research into thermochemical convection.

Σίδερο στο βάθος
Όταν η καρδιά της Γης άρχισε να παγώνει

Ο εσώτερος πυρήνας της Γης, μια μπάλα από μασίφ σίδερο λίγο μεγαλύτερη από τον Πλούτωνα, πρέπει να σχηματίστηκε νωρίτερα από ό,τι είχε εκτιμηθεί ως σήμερα, εκτιμά νέα μελέτη στο Nature. Και η εκτίμηση έχει σημασία για το μέλλον της ζωής στη Γη.



Η Γη αποτελείται από τέσσερα στρώματα: φλοιός, μανδύας, εξώτερος και εσώτερος πυρήνας (Πηγή: University of Michigan)

Το εξωτερικό στρώμα της Γης είναι ο λεπτός φλοιός, κάτω από τον οποίο υπάρχουν τα θερμά πετρώματα του μανδύα. Πιο κάτω, σε βάθος περίπου 3.000 χιλιομέτρων, βρίσκεται ένας εξώτερος μανδύας από ρευστό σίδηρο και νικέλιο. Στο κέντρο του βρίσκεται ο εσώτερος, στερεός πυρήνας. με διάμετρο γύρω στα 1.200 χιλιόμετρα, ο οποίος σταδιακά μεγαλώνει και μεγαλώνει.

Ο εσώτερος πυρήνας σχηματίστηκε από την πήξη, ή στερεοποίηση, του ρευστού σιδήρου καθώς η νεογέννητη Γη έχανε θερμότητα από το εσωτερικό της. Ο στερεός σίδηρος βυθίστηκε στο κέντρο, καθώς έχει μεγαλύτερη πυκνότητα από τον λιωμένο σίδηρο.

Οι εκτιμήσεις για το πότε αυτό συνέβη ποικίλλουν, από τα 500 εκατομμύρια μέχρι τα 2 δισεκατομμύρια χρόνια πριν.

Στη νέα μελέτη (http://www.nature.com/nature/journal/v526/n7572/full/nature15523.html), γεωλόγοι του Πανεπιστημίου του Λίβερπουλ στη Βρετανία εξετάζουν αρχαία πυριγενή πετρώματα, δηλαδή βράχους που σχηματίστηκαν από τη στερεοποίηση μάγματος. Πολλά πετρώματα περιέχουν σωματίδια μαγνητικών υλικών όπως ο σίδηρος, και διατηρούν έτσι μια μνήμη της έντασης και της κατεύθυνσης του μαγνητικού πεδίου της Γης την εποχή που σχηματίστηκαν.

Οι μετρήσεις έδειξαν ότι η ένταση του μαγνητικού πεδίου αυξήθηκε απότομα πριν από περίπου 1 με 1,5 δισεκατομμύρια χρόνια. Η αύξηση αυτή είναι πιθανό να συνέπεσε χρονικά με την έναρξη του σχηματισμού του εσώτερου πυρήνα, λένε οι ερευνητές.

Το μαγνητικό πεδίο δημιουργείται από ρεύματα λιωμένου, ηλεκτρικά αγώγιμου σιδήρου στον εξώτερο πυρήνα. Τα ρεύματα, με τη σειρά τους, δημιουργούνται λόγω της θερμότητας που διαρρέει από τον εσώτερο πυρήνα και αναδεύει τον λιωμένο σίδηρο στον εξώτερο πυρήνα.

Η στερεοποίηση του σιδήρου στο κέντρο της Γης, εκτιμά η μελέτη, ισχυροποίησε αυτά τα ρεύματα, αφού η βύθιση του στερεού σιδήρου ανάγκασε τον ρευστό σίδηρο, μαζί με άλλα, ελαφρύτερα στοιχεία, να μετακινηθούν από το κέντρο σε μικρότερα βάθη.

Η χρονολόγηση του εσώτερου μανδύα έχει σημασία για το μαγνητικό πεδίο, επισημαίνουν οι ερευνητές: όταν η διαδικασία ολοκληρωθεί και ο πυρήνας στερεοποιηθεί εντελώς, το μαγνητικό πεδίο θα εξαφανιστεί, και θα πάψει έτσι να προστατεύει τη Γη από τα φορτισμένα σωματίδια της ηλιακής και κοσμικής ακτινοβολίας.

Ο εσώτερος πυρήνας παραμένει ρευστός επειδή διατηρεί ένα μέρος της θερμότητας της νεογέννητης Γης, η οποία ήταν κάποτε μια διάπυρη μπάλα από μάγμα. Ο πυρήνας όμως συνεχίζει να παράγει θερμότητα λόγω της διάσπασης φυσι-κών ραδιενεργών στοιχείων όπως το ουράνιο.

«Το θεωρητικό μοντέλο που ταιριάζει περισσότερο με τα δεδομένα μας υποδεικνύει ότι ο εσώτερος μανδύας χάνει θερμότητα πιο αργά από ό,τι οποιαδήποτε στιγμή τα τελευταία 4,5 δισεκατομμύρια χρόνια» αναφέρει ο Άντι Μπίγκιν, πρώτος συγγραφέας της δημοσίευσης.

«Αυτή η ροή ενέργειας θα πρέπει να κρατήσει ζωντανό το μαγνητικό πεδίο για ένα δισεκατομμύριο χρόνια ή και περισσότερο».

Το τι θα συμβεί στη Γη όταν χάσει το προστατευτικό πεδίο της είναι εμφανές στον σημερινό Άρη. Ο γειτονικός πλανήτης είναι τρεις φορές μικρότερος από τη Γη και κρύωσε πιο γρήγορα, οπότε έχασε τον ρευστό πυρήνα του και μαζί με αυτόν και το μαγνητικό πεδίο. Σήμερα, η επιφάνειά του είναι μια έρημος που βομβαρδίζεται από θανάσιμα επίπεδα ακτινοβολίας.

(Βαγγέλης Πρατικάκης / Newsroom ΔΟΛ, 08 Οκτ. 2015, http://news.in.gr/science-technology/article/?aid=1500031289)

Palaeomagnetic field intensity variations suggest Mesoproterozoic inner-core nucleation

A. J. Biggin, E. J. Piispa, L. J. Pesonen, R. Holme, G. A. Paterson, T. Veikkolainen, L. Tauxe

Nature, **526**, 245–248 (08 October 2015) doi:10.1038/nature15523

The Earth's inner core grows by the freezing of liquid iron at its surface. The point in history at which this process initiated marks a step-change in the thermal evolution of the planet. Recent computational and experimental studies have presented radically differing estimates of the thermal conductivity of the Earth's core, resulting in estimates of the timing of inner-core nucleation ranging from less than half a billion to nearly two billion years ago. Recent inner-core nucleation (high thermal conductivity) requires high outer-core temperatures in the early Earth that complicate models of thermal evolution. The nucleation of the core leads to a different convective regime and potentially different magnetic field structures that produce an observable signal in the palaeomagnetic record and allow the date of inner-core nucleation to be estimated directly. Previous studies searching for this signature have been hampered by the paucity of palaeomagnetic intensity measurements, by the lack of an effective means of assessing their reliability, and by shorter-timescale geomagnetic variations. Here we examine results from an expanded Precambrian database of palaeomagnetic intensity measurements selected using a new set of reliability criteria. Our analysis provides intensity-based support for the dominant dipolarity of the time-averaged Precambrian field, a crucial requirement for palaeomagnetic reconstructions of continents. We also present firm evidence for the existence of very long-term variations in geomagnetic strength. The most prominent and robust transition in the record is an increase in both average field strength and variability that is observed to occur between a billion and 1.5 billion years ago. This observation is most readily explained by the nucleation of the inner core occurring during this interval; the timing would tend to favour a modest value of core thermal conductivity and supports a simple thermal evolution model for the Earth.

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΠΕΡΙΒΑΛΛΟΝ

Εικόνες της καταστροφής

Νεκρά Θάλασσα: Τι συμβαίνει στη γη όταν το νερό εξαφανίζεται

Νεκρά Θάλασσα: Καθώς η στάθμη πέφτει, το έδαφος υποχωρεί.

Η Νεκρά Θάλασσα πεθαίνει λόγω των ανθρώπινων παρεμβάσεων, με τη στάθμη του νερού να υποχωρεί κατά περισσότερο από ένα μέτρο το χρόνο. Μια από τις συνέπειες είναι οι εκατοντάδες καταβόθρες που εμφανίζονται κατά μήκος των ξερών ακτών -κάποιες σε μέγεθος γηπέδου, άλλες αρκετά βαθιές για να καταπιούν ολόκληρα σπίτια.

Η Νεκρά Θάλασσα, στην πραγματικότητα μια λίμνη κορεσμένη με αλάτι, βρέχει την Ιορδανία, το Ισραήλ και τη Δυτική Όχθη. Έχει χαμηλότερο υψόμετρο από κάθε άλλη περιοχή του πλανήτη, με την επιφάνειά της να βρίσκεται σήμερα 429 μέτρα κάτω από την επιφάνεια της θάλασσας.

Το νερό, που εισρέει στη λεκάνη από τον ποταμό Ιορδάνη στα βόρεια και από μερικά ρυάκια στα ανατολικά, δεν έχει καμία οδό διαφυγής. Ως αποτέλεσμα, η συγκέντρωση αλατιού είναι σχεδόν δέκα φορές μεγαλύτερη από ό,τι στο θαλασσινό νερό -οι Άραβες, μάλιστα, την ονομάζουν Μπαρ Λουτ, που σημαίνει «Θάλασσα του Λοτ».

Τις τελευταίες δεκαετίες η Νεκρά Θάλασσα έχει συρρικνωθεί δραματικά, καθώς οι γύρω χώρες αντλούν νερό από τον Ιορδάνη ποταμό και τα μικρότερα ποτάμια που την τροφοδοτούν.

Οι καταβόθρες ήταν κάποτε σπάνιο φαινόμενο, πλέον όμως εμφανίζονται κατά εκατοντάδες κάθε χρόνο, και έχουν ήδη καταπιεί πυλώνες του δικτύου ηλεκτροδότησης, τροχόσπιτα και μικρά κτήρια.

Σε τουλάχιστον μία περίπτωση, αναφέρει το Reuters, τουρίστες τραυματίστηκαν πέφτοντας στις τρύπες. Πριν από έξι μήνες, ο δρόμος στον άξονα βορρά-νότου που διέρχεται από το Ισραήλ και τη Δυτική Όχθη χρειάστηκε να κλείσει λόγω ενός λάκκου που εμφανίστηκε στην άσφαλτο.

Το φαινόμενο οφείλεται στην υποχώρηση του αλμυρού νερού. Αυτό δίνει την ευκαιρία σε γλυκό νερό του υδροφόρου ορίζοντα να ξεπλύνει το αλάτι από το έδαφος, δημιουργώντας έτσι κοιλότητες που τελικά καταρρέουν και σχηματίζουν καταβόθρες.

Λύση δεν φαίνεται να υπάρχει στον ορίζοντα. Το 2013, το Ισραήλ, η Ιορδανία και η Παλαιστινιακή Αρχή αποδέχτηκαν σχέδιο της Παγκόσμιας Τράπεζας για αναζωογόνηση της Νεκράς Θάλασσας με αλμυρό νερό που περισσεύει από εγκαταστάσεις αφαλάτωσης στην Ερυθρά Θάλασσα.

Παραμένει ασαφές αν το πρόγραμμα θα υλοποιηθεί, και οι περιβαλλοντικές οργανώσεις το χαρακτηρίζουν σταγόνα στον ωκεανό.

(Βαγγέλης Πρατικάκης / Newsroom ΔΟΛ, 08 Σεπ. 2015, http://news.in.gr/science-technology/article/?aid=1500024031&ref=newsletter)

Atlantropa: the colossal 1920s plan to dam the Mediterranean and create a supercontinent

Egyptian billionaire Naguib Sawiris recently announced plans to buy a Greek island to give refugees from the Middle East and Africa a country of their own. Though Sawiris referred to his proposal as a "crazy idea" on Twitter, it pales in comparison to an earlier scheme for the Mediterranean from the first half of the 20th century, which was seriously considered by heads of state and, at one point, even the United Nations. It was called Atlantropa, and would have involved the partial draining of the Mediterranean Sea and the creation of a Eurafrican supercontinent.

Atlantropa was the brainchild of the German architect Herman Sörgel, who tirelessly promoted his project from 1928 until his death in 1952. His experience of World War I, the economic and political turmoil of the 1920s and the rise of Nazism in Germany convinced Sörgel that a new world war could only be avoided if a radical solution was found to European problems of unemployment, overpopulation and, with Saudi oil still a decade away, an impending energy crisis. With little faith in politics, Sörgel turned to technology.

Dams across the Strait of Gibraltar, the Dardanelles, and eventually between Sicily and Tunisia, each containing gigantic hydroelectric power plants, would form the basis for the new supercontinent. In its final state the Mediterranean would be converted into two basins, with the western part lowered by 100 meters and the eastern part by 200 meters and a total of 660,200 km^2 of new land reclaimed from the sea – an area larger than France.

Later plans for Atlantropa also included two dams across the Congo River and the creation of a Chad and Congo Sea, which Sörgel hoped would have a moderating influence on the African climate making it more pleasant for European settlers. In line with the colonial and racist attitudes of the times, Sörgel envisaged Africa with its resources and its land to be entirely at the disposal of Europe, a continent with plenty of space to accommodate Europe's huddled masses.

While Sörgel's proposal may sound absurd to our ears, it was taken seriously by architects, engineers, politicians and journalists at the time. The extensive Atlantropa archive in the Deutsche Museum in Munich (http://www.deutsches-museum.de/en/research/projects/focal-point-i/cluster-1/) abounds with architectural drawings for new cities, the dams and bridges of the future continent as well as letters of support and hundreds of articles about the project, which appeared in the German and international popular press as well as in specialised engineering and geographical magazines.

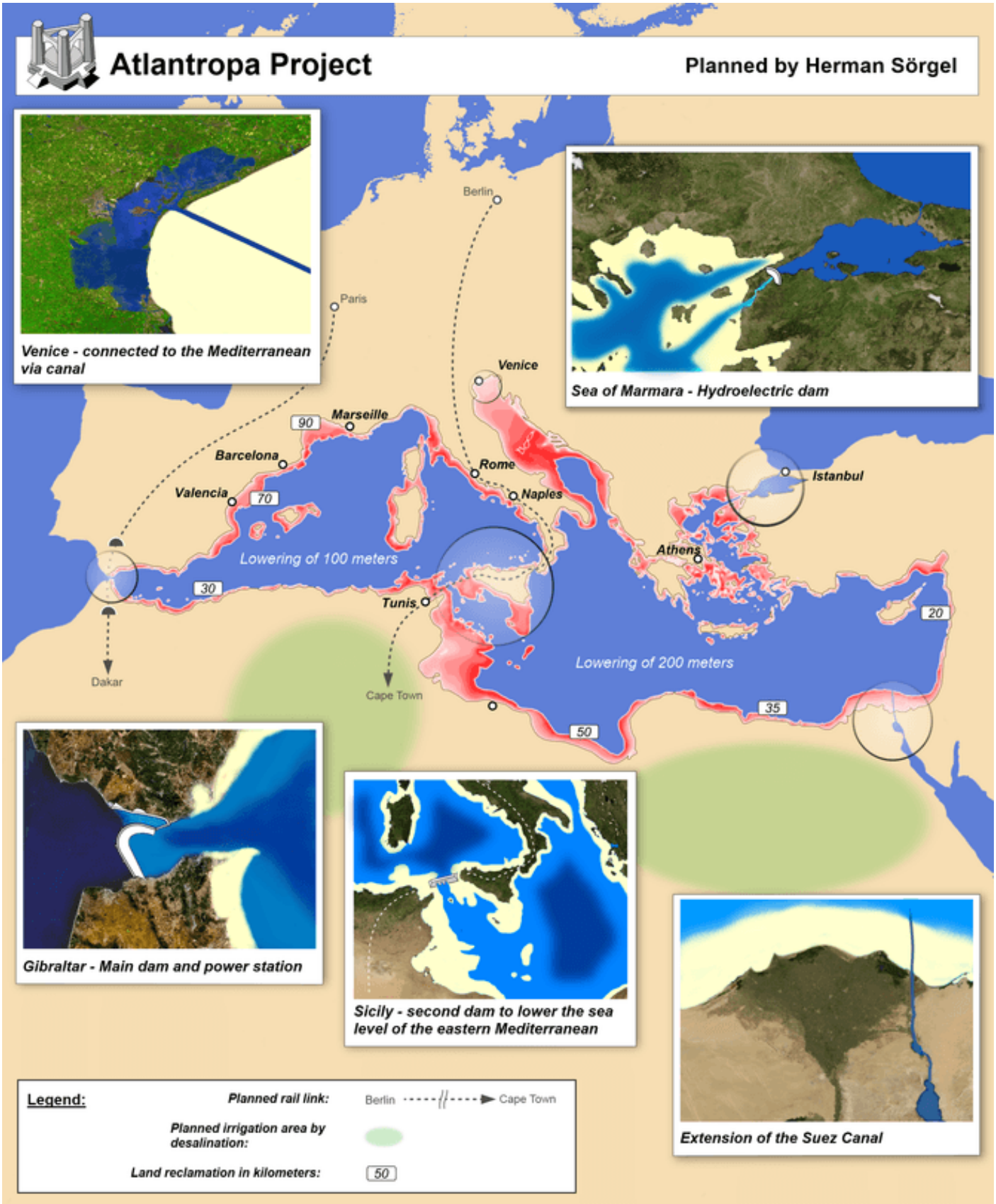
What made Atlantropa so attractive was its vision of world peace achieved not through politics and diplomacy, but with a simple technological solution. Atlantropa would be held together by a vast energy net, which would extend from the gigantic hydroelectric plant in the Gibraltar dam and provide the entirety of Europe and Africa with electricity. The power plant would be overseen by an independent body who would have the power to switch off the energy supply to any individual country that posed a threat to peace. Moreover Sörgel calculated that the construction of the supercontinent would require each country to invest so much money and people power that none would have sufficient resources to finance a war.

Putting his faith in the people of Europe and their desire for peace, Sörgel dedicated a large part of his work to the promotion and dissemination of the project through the popular press, radio programmes, films, talks, exhibitions and even poetry and an Atlantropa symphony. He hoped popular support would help him get the backing of politicians.

Unsurprisingly, in the eyes of his contemporaries the required collaboration between nation states always appeared even more utopian than the vast technological dimensions of Atlantropa. As the New York-based magazine UN World observed in 1948:

Harnessing Gibraltar for mankind's good does sound like a dream, but in this 20th century no dream – not even that of cooperation among nations – is quite impossible.

By 2012, when the European Union was awarded the Nobel Peace Prize in acknowledgement of its contribution to lasting peace in Europe, the hope expressed by the UN World appeared to finally have come true. However, in 2015, cooperation among nations sadly looks like a distant dream once again. Where once Herman Sörgel had used the image of a Europe bursting at the seams that is saved by a peaceful merger with the African continent, we are now confronted with the mirror image as people from across Africa and the Middle East seek refuge in Europe.



Now would be the time to prove that the Peace Prize was indeed deserved. Now would be the time to show solidarity and unity. Instead, the EU appears on the brink of being torn apart over its inability to find a communal solution to accommodate a group of refugees, whose number ultimately comes to no more than a meagre 0.11% of the overall population of the Union. Sadly European unity, and with it a solution for the refugee crisis, once again appears more utopian than Sörgel's plans for draining the sea.

Clips from 1951 Atlantropa film (https://www.youtube.com/watch?t=44&v=Ahw7wOlGpR4)

(Ricarda Vidal - Lecturer in Visual Culture and Cultural History, King's College London / The Conversation, September 17, 2015, https://theconversation.com/atlantropa-the-colossal-1920s-plan-to-dam-the-mediterranean-and-create-a-supercontinent-47370)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

Η βιβλιοθήκη της Αλεξανδρείας

Μια εκπληκτική παρουσίαση της βιβλιοθήκης της Αλεξανδρείας και της Υπατίας από τον ανυπέρβλητο Carl Sagan. https://www.youtube.com/embed/jr9lAS6cxt4?rel=0

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

www.geoengineer.org

Κυκλοφόρησε το Τεύχος #127 του **Newsletter του Geoengineer.org** (Σεπτεμβρίου 2015) με πολλές χρήσιμες πληροφορίες για όλα τα θέματα της γεωμηχανικής. Υπενθυμίζεται ότι το Newsletter εκδίδεται από τον συνάδελφο και μέλος της ΕΕΕΕΓΜ Δημήτρη Ζέκκο (secretariat@geoengineer.org).

ISRM International Society for Rock Mechanics NEWSLETTER

No.31, September 2015
www.isrm.net/adm/newsletter/ver_html.php?id_newsletter=117&ver=1

Κυκλοφόρησε το Τεύχος 31 (Σεπτεμβρίου 2015) με τα παρακάτω περιεχόμενα:

- 2016 ISRM International Symposium
- ISRM Symposium EUROCK2015 and 64th Geomechanics Colloquium
- VIII South American Congress on Rocks Mechanics
- ARMS9, Bali, 18-20 October 2016: Call for papers
- 11th ISRM online lecture by Dr Nick Barton was broadcast and is now online
- ISRM Rocha Medal 2017 - nominations to be received by 31 December 2015
- New ISRM National Group of Iceland
- FedIGS website has been launched
- Rock Stress 2016, 7th International Symposium on In-Situ Rock Stress
- Invitation to RockDyn-2, May 2016, Suzhou, China, an ISRM Specialised Conference
- Geosafe 2016 to be held in Xi'an, 25–27 May 2016: an ISRM Specialised Conference
- China Shale Gas 2015 - Successful I SRM Specialised Conference in Wuhan, China
- Prestigious Turkish Tunnelling Society Award given during the Turkey Tunnel-Expo 2015
- ISRM Sponsored Meetings

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2012 – 2015)

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