ΕΛΛΗΝΙΚΗ
ΕΠΙΣΤΗΜΟΝΙΚΗ
ΕΤΑΙΡΕΙΑ
ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ
& ΓΕΩΤΕΧΝΙΚΗΣ
ΜΗΧΑΝΙΚΗΣ

Τζουμέρκα καθ' οδόν προς Συρράκο

Τα Νέα της Ε Ε Ε Ε Γ Μ

175

Αρ. 175 – ΜΑΙΟΣ 2023

Άραχθος, Τζουμέρκα

SIMSG ISSMGE

ISRM

ISSN: 2732-7248

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

ΑΡΘΡΑ

Landslides are a global injustice – they're rarely caused by the people worst affected

Dave Petley

Joshimath is slowly sliding. Amol_M / shutterstock

In northern India, a tragedy is playing out in slow-motion. Located at about 2,000 metres elevation in Chamoli District in the Himalayas, Joshimath is an ancient, sacred town of about 17,000 people. Popular with pilgrims and visitors wanting to ski or climb the nearby mountains, the town is a beautiful refuge from the bustle of the plains.

Late in 2022, a new chapter started in the long history of Joshimath as cracks started to develop in buildings across the town. These quickly spread over a large area, ripping apart roads, houses and hotels. These events were widely reported by the Indian media, which generally ascribed them to "subsidence". The reality is something else: the town is built upon debris from an ancient landslide.

And that landslide has started to move.

The age of the landslide is unclear, but it is likely to be hundreds or even thousands of years old. The debris has been covered with soil and plants, hiding it from sight and giving local people the impression they were living on solid ground.

Joshimath resident Chandra Pandey stands beside deep cracks in his house. Rajesh Kumar Singh / Alamy

The existence of the landslide, and the hazard that it poses, was identified about 50 years ago, but little action has been taken to mitigate the risk. To date at least 860 houses have been rendered uninhabitable, and the landslide continues to move. Hundreds of people are living in temporary camps, with no real clarity as to their future prospects, and thousands more worry that the landslide movement will spread to their part of the town.

Why the landslide started moving again in late 2022 is unclear. In the past few months many fingers have been pointed. Over the past decade, a large hydroelectric "run of the river" scheme has been built in the valleys near the town, which meant building tunnels beneath Joshimath. Shaking caused by blasting has been reported throughout the area. It is unsurprising that people believe that there is a link.

In early 2021, a large debris flow swept down the valley below Joshimath, triggered by the collapse of a mountainside high in the mountains, severely damaging the dam from the hydroelectric power scheme and killing over 200 people, mostly dam workers. Some people link the reactivation of the Joshimath landslide to this flow.

A third theory is that climate change, which has caused more intense rainfall in the area, has triggered the landslide. All of these mechanisms are possible. In the absence of detailed scientific investigations, rumours dominate.

Many other Joshimaths go unreported

Sadly, Joshimath is not an isolated case. Landslides are destroying communities right across the high mountains of South Asia, most frequently small, isolated settlements that do not command the attention that has been heaped on Joshimath. Over and again, people lose their major economic assets – their house and land – and are rendered destitute. Women and girls often fare particularly poorly in these circumstances.

In the vast majority of cases, the landslides result from things outside of the control of the people affected, making these events a travesty of social justice. At the macro-level, the increases in rainfall intensity that are occurring in many mountain areas result principally from greenhouse gas emissions that occurred thousands of kilometres away in far richer economies.

In other cases, the landslides are the result of large energy projects that will bring security of supply to distant cities, while isolated communities may still have no reliable supply, and that will generate profits that will bring little benefit to the mountain regions. More locally, landslides often result from roads that serve to bypass their communities, and are sometimes associated with local corruption as, for example, the owners of construction machinery bribe officials to allow road building in unsuitable areas.

Aftermath of a recent landslide 1,000km away in Kashmir. Sipa / Alamy

A safety net for landslide victims

There is a paucity of social justice, or even of discussion about social justice, when it comes to these landslides. The victims at every stage are the local people, who lose their home, their land, their possessions and their livelihood, and sometimes their lives. Even in richer countries landslides are often not an insurable risk, in contrast to floods or windstorms. For most people it is not possible to assess the likelihood of a property being affected by a landslide, so home owners are in effect having to gamble.

It is time to make changes. In the mountains of South Asia, the current rampant, poorly-coordinated development needs to be controlled for the sake of the environment and the local population. There is no case for an embargo on construction across the region, but there is a strong rationale for ensuring that there are proper technical assessments of large schemes; for environmental impact assessments that are scientifically rigorous; for land use planning controls on the basis of hazard and for the careful management of water. When things go wrong, and they will, there is a need for a safety net, either through insurance or through government schemes.

Sadly, failure to act will further drive inequality, causing a further breakdown in the fragile social balance of high mountain areas.

(Dave Petley / THE CONVERSATION, May 4, 2023, https://theconversation.com/landslides-are-a-global-injustice-theyre-rarely-caused-by-the-people-worst-affected-201885)

I've written a piece about landslides as an issue of social justice for The Conversation enitled: "Landslides are a global injustice – they're rarely caused by the people worst affected":

Dave Petley, May 5, 2023, https://twitter.com/davepetley/status/1654380783199559680?cxt=HBwWgIC9ndOjxfUtAAAA&cn=ZmxleGlibGVfcmVjcw%3D%3D&refsrc=email)

Hydrogeological Hazards in Open Pit Coal Mines
The Amyntaio open pit coal mine (Greece)

UNESCO Land Subsidence International Initiative

The Amyntaio open pit coal mine (Greece) became instantaneously famous on 10 June 2017 by producing one of the biggest landslides ever recorded in human history. In total, 80 million m3 of debris came down, extending over an area of 2.0 by 2.2 km. The landslide caused the permanent evacuation of parts the nearby village Anargyroi. Luckily no one was hurt, because the mine was evacuated days before the landslide.

Severe groundwater pumping in the decades before the disaster, necessary to prevent the mine from inundating, resulted in a 3 km subsidence bowl surrounding the mine. The creation of the subsidence bowl damaged nearby villages and infrastructure. To mitigate subsidence, the water table in the upper most aquifer was increased again in 2016. A new study by Ploutarchos Tzampoglou, Ph.D. and Constantinos Loupasakis revealed however, that although this mitigated subsidence, it also affected ground stability in the area. Together with unfavorable mine slope geometry, this instability probably eventually triggered the landslide event.

The article is published in Water, and can be found here: https://lnkd.in/e7qxG7jJ

Constantinos Loupasakis • Professor at National Technical University of Athens, 2 May 2023

The Destructive Earthquake Doublet of 6 February 2023 in South-Central Türkiye and Northwestern Syria: Initial Observations and Analyses

P. Martin Mai; Theodoros Aspiotis; Tariq Anwar Aquib; Eduardo Valero Cano; David Castro-Cruz; Armando Espindola-Carmona; Bo Li; Xing Li; Jihong Liu; Rémi Matrau; Adriano Nobile; Kadek Hendrawan Palgunadi; Matthieu Ribot; Laura Parisi; Cahli Suhendi; Yuxiang Tang; Bora Yalcin; Ulaş Avşar; Yann Klinger; Sigurjón Jónsson

Abstract

On 6 February 2023, two large earthquakes with magnitude 7.8 and 7.6 rocked south-central Türkiye and northwestern Syria. At the time of writing, the death toll exceeded 50,000 in Türkiye and 7200 in Syria. The epicenter of the first mainshock was located ~15 km east of the east Anatolian fault (EAF), the second large earthquake (9 hr later) initiated ~90 km to the north on the east–west-trending Sürgü fault. Aftershocks delineate fault lengths of ~350 and ~170 km, respectively. Using satellite and seismic data for first-order analyses of surface-fault offsets, space–time rupture evolution, and recorded ground motions, our study sheds light on the reasons for the extensive destruction. The first event ruptured the EAF bilaterally, lasted for ~80 s, and created surface fault offsets of over 6 m. The second event also ruptured bilaterally with a duration of ~35 s and more than 7 m surface offsets. Horizontal ground accelerations reached locally up to 2*g* in the first mainshock; severe and widespread shaking occurred in the Hatay-Antakia area with values near 0.5*g*. Both earthquakes are characterized by directivity effects and abrupt rupture cessation generating stopping phases that contributed to strong seismic radiation. Shaking was further aggravated locally by site-amplification effects.

Introduction

The two devastating earthquakes of 6 February 2023, and their associated aftershock sequences, in south-central Türkiye and northwestern Syria are sobering reminders that earthquakes can neither be predicted nor prevented, but can only be prepared for. The earthquakes were the deadliest ones in Türkiye for centuries. The two strong earthquakes occurred in rapid succession but on different faults. The epicenter of the first shock of magnitude *M*w 7.8 was located ~15 km east of the east Anatolian fault (EAF) at 37.288° N, 37.043° E, 8.6 km depth, (origin time 01:17 a.m. UTC). Only 09:07 hr later, the second event (magnitude *M*w 7.6) initiated 90 km north of the EAF on the east–west-trending Sürgü fault (38.089° N, 37.239° E, 7.0 km depth, origin time 10:24 a.m. UTC).

The EAF defines the active plate boundary between the Arabian and the Anatolian plates (Fig. 1a). Over its ~500 km length, the left-lateral EAF has an estimated slip rate of ~10 mm/yr (Aktug *et al.*, 2016). Together with the right-lateral north Anatolian fault (NAF), the EAF bounds the westward extrusion of the Anatolian plate from the Arabia–Eurasia collision zone (Pousse-Beltran *et al.*, 2020, and references therein). The section of the EAF that broke in the first mainshock extends into the Hatay triple junction between the EAF, the Cyprus arc, and the Dead Sea fault branching to the south (Fig. 1b).

During the last ~100 yr, both the NAF and EAF varied in terms of releasing tectonic stress in large earthquakes. The NAF produced a sequence of large earthquakes in the twentieth century that initiated with the 1912 *M*w 7.2 Ganos earthquake at the western end of the Marmara Sea and then continued with the devastating *M*w 7.8 Erzincan earthquake in 1939 on the eastern NAF that killed over 30,000 people. This tragic quake was followed by 10 moderate-to-large events (1942–1967; Barka, 1996) and the 1999 *M*w 7.6 Izmit and *M*w 7.2 Düzce earthquakes east of the Marmara Sea, leaving major fault segments near Istanbul unbroken since 1766. In contrast, only three moderately sized earthquakes occurred on the EAF in the last ~50 yr (1971 *M*w 6.7; 2020 *M*w 6.1; and 2020 *M*w 6.8), located on the northwestern section of the EAF. However, large historical earthquakes are documented along the southern EAF (Ambraseys, 2009; Meghraoui, 2015), such as in 1114 B.C.E. *M*w~7.8□ 1872 B.C.E. *M*w~7.2□ and 1822 B.C.E. *M*w~7.5. The second rupture of the 2023 earthquake sequence occurred on the Sügür fault—a side branch of the EAF strand that is thought to have last ruptured in 1544 B.C.E. (Fig. 1a). The seismic activity of the NAF and EAF is reflected in corresponding seismic hazard maps (e.g., Akkar *et al.*, 2018; Demircioğlu *et al.*, 2018; Pagani *et al.*, 2018; Şeşetyan *et al.*, 2018; Fig. 1b).

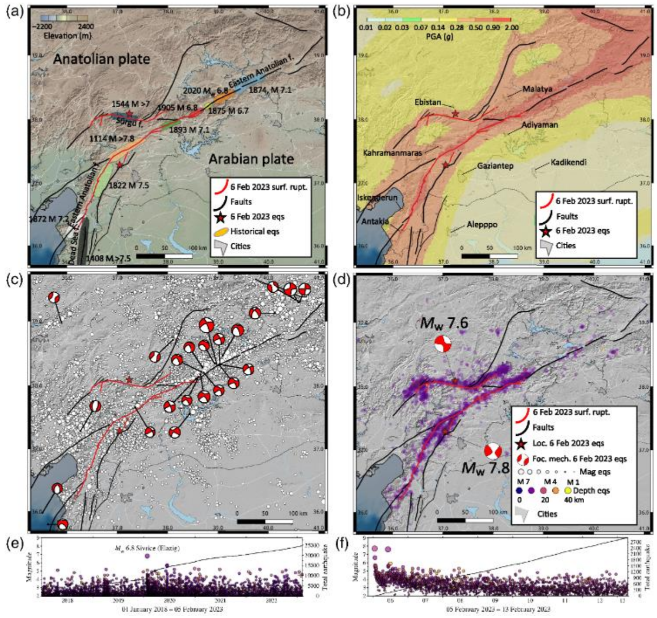


Fig. 1. Seismotectonic overview of the east Anatolian fault region, with the main faults (black lines) and the mapped surface ruptures of the *M*w 7.8 and 7.6 earthquakes of 6 February 2023 (red lines). (a) Tectonic setting and historical earthquakes (after Ambraseys, 2009; Meghraoui, 2015). (b) Seismic hazard map (peak ground acceleration [PGA], 10% probability to be exceeded in 50 yr) extracted from the Turkish Seismic Hazard Map (by Disaster and Emergency Management Authority [AFAD]). (c) Background seismicity (□*M*w≥2 from AFAD) from 1 January 2018 to 5 February 2023, with focal mechanisms of earthquakes of magnitude *M*w≥4.8 (from Global Centroid Moment Tensor [Global CMT] catalog). (d) One-week aftershocks (□*M*w≥2 from AFAD), and focal mechanism the *M*w 7.8 and 7.6 earthquakes of 6 February 2023. (e) Time series of background seismicity shown in panel (c). (f) Time series of aftershocks shown in panel (d). For details, see Data and Resources.

In the past ~100 yr, only a few continental strike-slip earthquakes with magnitudes exceeding *M*w 7.5 occurred, limiting the available data and hence detailed studies of such large earthquakes. Examples are the 1990 *M*w 7.8 Luzon, Philippines, the 2001 *M*w 7.8 Kunlun, China, the 2002 *M*w 7.9 Denali, Alaska, the 2013 *M*w 7.7 Balouchistan, Pakistan, and the 2016 *M*w 7.8 Kaikoura, New Zealand, events. Each of these earthquakes revealed an intricate rupture process related to geometrical fault complexities (Klinger, 2022, and references therein): rupture lengths exceeding 100 km and reaching up to 300 km (2001 Kunlun earthquake); average horizontal surface slip of 3–4 m, reaching locally up to 7–9 m, and strongly varying along-strike in relation to the fault-trace geometry.

The unique character of the 2023 sequence is that two large-magnitude earthquakes occurred only 9 hr apart on nearby faults. Pairing of large continental earthquakes over such a short time had not been observed before. Previous pairing always involved longer separation in time, like 14 days between the *M*w ~8 Tsetserleg and *M*w ~8 Bulnay events (Choi *et al.*, 2018) and 4 months for the *M*w 7.4 Izmit–*M*w 7.2 Düzce sequence (Konca *et al.*, 2010). In addition, the spatial dimensions of the two main 2023 quakes estimated from real-time aftershock locations (Fig. 1b) reach lengths of ~350 km on the EAF for the initial *M*w 7.8 earthquake and ~170 km for the *M*w 7.6 earthquake on the Sürgü fault. For the regional seismogenic width of 20 km (Ozer *et al.*, 2019), these source dimensions are consistent with the events' magnitudes based on source-scaling relations (Thingbaijam *et al.*, 2017).

Fault Surface Displacements from Satellite Data

We used pixel-offset tracking of Sentinel-1 radar images to map coseismic surface displacements around the two faults and the extent of surface fault rupturing (e.g., Fialko *et al.*, 2001; Wang and Jónsson, 2015). Based on ascending and descending orbit images, as well as along-track (azimuth) and across-track (range), we derived pixel offsets (Fig. S1, available in the supplemental material to this article), yielding four different offset images from which we inverted for 3D surface displacements (Liu *et al.*, 2022; Fig. S2). The resulting horizontal surface displacements and their spatial pattern exhibit left-lateral motion across the two main faults (Fig. 2a). Vertical displacements are small in comparison (Fig. S2c), confirming the almost pure strike-slip mechanism of both events. The length of the main surface rupture along the EAF in the first earthquake is ~320 km, whereas the surface rupture of the second mainshock is markedly shorter (~150 km). Hence, for both cases the mapped surface rupture is 20–30 km shorter than indicated by aftershock locations (Fig. 1d).

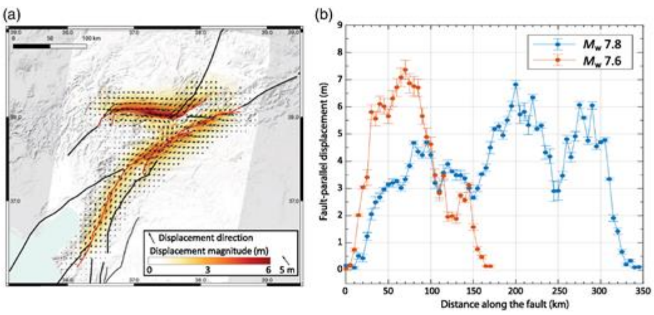


Fig. 2. Coseismic horizontal surface displacements of the Kahramanmaraş earthquakes. (a) Map of the amplitude and direction of horizontal displacements derived from pixel-tracking offsets of Sentinel-1 satellite radar images (see Fault Surface Displacements from Satellite Data section, as well as the supplemental material, Figs. S1 and S2). The red lines show mapped surface ruptures. (b) Fault-parallel displacements along the two fault ruptures from southwest to northeast.

Both earthquakes produced large surface-fault offsets (exceeding 4 m) over extended sections along the faults (Fig. 2). From their horizontal surface displacement fields, we measured fault offsets at 5 km intervals along the two main faults. The results show that surface fault slip along the EAF has 2–3 slip maxima, with the largest slip found northeast of the epicenter (6–7 m), ~30 km east of the city of Kahramanmaras. Another slip maximum (~4 m) is found farther southwest, near Islahiye, with fault slip abruptly decreasing near Antakia at the southwestern end of the rupture. The maximum surface offset of the second fault is even larger than for the first rupture, exceeding 7 m near the epicenter and 6 m over a fault length of ~60 km (Fig. 2b). This large surface offset may compensate the relatively short rupture length for the measured magnitude of *M*w 7.6.

Rupture Process from Backprojection and Finite-Fault Modeling

Using far-field teleseismic data, we estimated the space–time rupture evolution via backprojection (e.g., Ishii *et al.*, 2005; Koper *et al.*, 2011; Li and Ghosh, 2017) and finite-fault modeling (e.g., Mendoza and Hartzell, 2013, and references therein). For this purpose, we compiled two datasets. For the backprojection, we used seismic stations in Alaska and selected only stations with average cross correlation (CC) above 0.6 for the first 25 s around the *P*-phase arrival filtered in the range 0.1–2 Hz. This results in 205 and 201 stations for the *M*w 7.8 and 7.6 events, respectively. The targeted backprojection region extends from 35° to 39.5°, both in latitude and longitude, with 0.01° grid spacing in both the directions. We calculated theoretical travel times based on the Preliminary Reference Earth model from the source grid to each seismic station, with source depths fixed at catalog depths. In addition, we applied time shifts and relative polarity estimation from the peak cross-correlation (CC) coefficients of the first arrival *P* phases for a shorter 5 s time window, relative to a reference station with maximum average CC coefficients, as empirical time and polarity correction. To then image the rupture evolution, we deployed a 6 s sliding time window and 0.1 s time step to the continuous waveform data.

Backprojection results show bilateral rupture of the *M*w 7.8 earthquake, with an average rupture speed ~2.5 km/s to the east and ~2 km/s to the west, estimated using epicentral distance (which underestimates average rupture velocity along the fault itself if fault geometry changes; Fig. S3). However, with a priori knowledge of the fault traces and assuming nearly vertical dip angles, we were able to backproject the radiated seismic energy directly to the fault (Fig. 3). This better illustrates the complex rupture process of the *M*w 7.8 event (inset in Fig. 3f). The backprojection suggests bilateral rupture on a small fault east of the EAF where the hypocenter is located (Disaster and Emergency Management Authority [AFAD] catalog). Rupture to the southwest stopped after a few seconds but continued to the northeast until it reached the intersection with the EAF at ~10 s. The backprojection then locates strong radiation to the east, but near the intersection of the nucleation branch and the EAF. This correlates with the strongest recorded ground shaking at the station TK4614. The rupture continued to the northeast with an average rupture speed of ~3.1 km/s along the EAF until ~55 s rupture duration, with strong radiation from a short east–west branch of the fault, the junction between the EAF and the eastern extension of the Sürgü fault before it stopped ~25 km farther east of the junction (inset in Fig. 3f). The rupture to the southwest along the main EAF appears delayed with limited seismic radiation west of the epicentral region. However, continued rupture to the east may have altered the stress state on this segment, thereby promoting further rupture to the southwest until ~80 s, when rupture suddenly terminated near Antakia with strong observed seismic radiation.

Backprojection results of the *M*w 7.6 event reveal a frequency-dependent rupture process due to rupture directivity (Fig. 3e–h and Fig. S3; Li *et al.*, 2022). The 0.1–0.5 Hz results capture rupture to the east of the Sürgü fault, which then changed its direction toward the northeast. The 0.5–

1 Hz results, on the other hand, mainly track rupture to the west on the Sürgü fault. The two strong radiation sources are located where the fault geometry changes.

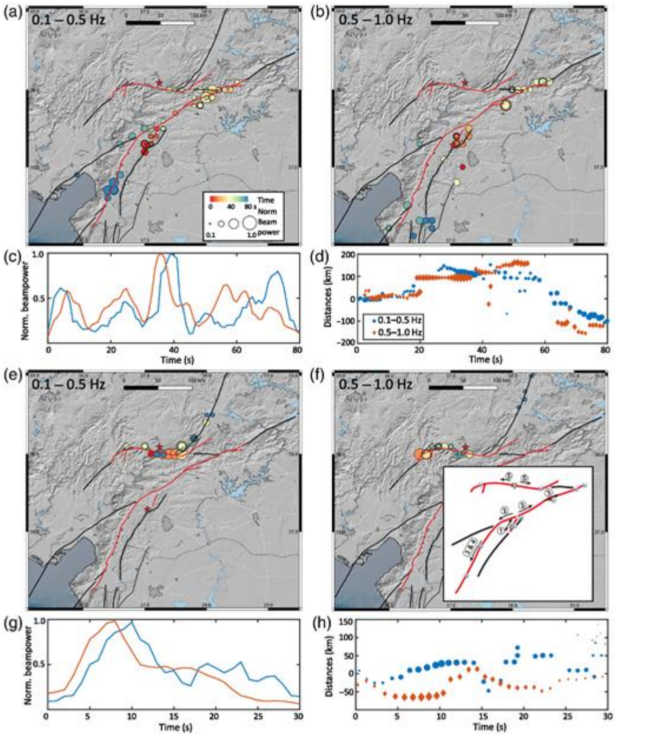


Figure 3. Backprojection results. (a) Backprojection results using the Alaska array data filtered in 0.1–0.5 Hz for the *M*w 7.8 earthquake. Circles mark the backprojected source locations at the corresponding rupture time, with circle size being proportional to the stacked waveform energy (beam power). (b) Same as panel (a) but for frequency range 0.5–1 Hz. (c) Normalized beam power evolution with rupture time (legend as in panel (d)). (d) Rupture distance (away from the epicenter) with time. Positive distance indicates rupture to the east of the epicenter, negative distance corresponds to westward rupture. (e–h) Same as panels (a–d) but for the *M*w 7.6 earthquake. In the inset of panel (f), numbered circles depict locations of strong seismic radiation inferred from the backprojection analysis. The arrow indicates the rupture direction, with the associated number representing the rupture sequence.

In addition to backprojection imaging, we estimated two sets of finite-fault source models for the two earthquakes, one from satellite radar data-derived coseismic horizontal surface displacements (Fig. 2a) and the other from teleseismic observations. For the geodetic source model, we used the fault traces mapped from satellite radar offsets, extended the fault lengths a few kilometers beyond the mapped surface ruptures, extended the fault widths to 25 km, and discretized them into 5 km × 5 km fault patches. The first fault is vertical, whereas the second mainshock fault dips 78° to the north. We then estimated spatially variable slip on the faults (e.g., Jónsson *et al.*, 2002) from the coseismic horizontal surface displacements using an appropriate degree of spatial fault-slip smoothing.

For inverting the teleseismic data to derive kinematic finite-fault source models, we downloaded seismic waveforms for stations situated at teleseismic distances of 30°–90°, ensuring good azimuthal coverage. By visual inspection, we selected 18 stations for the first mainshock (Fig. S4a) and 17 stations for the second event (Fig. S5a) with high signal quality, using initially only the *P* wavetrain. Waveforms were then band-pass filtered (5–20 s, Butterworth filter) to remove high-frequency noise. To infer kinematic finite-fault parameters, we only used vertical components and applied covariance matrices to account for errors in both measurements and theory (e.g., Vasyura-Batke *et al.*, 2020, and references therein). Because the kinematic finite-fault source-parameter estimation suffers from nonunique solutions, we explored the model space using Bayesian inference with sequential Monte Carlo sampling implemented in the Bayesian earthquake analysis tool (BEAT) code (Vasyura-Batke *et al.*, 2020; Figs. S4b and S5b).

The kinematic rupture model for the first main event comprises four major segments with uniform dip angle of 89°. Each segment is subdivided into 5 km × 5 km subfaults. Segment 1-a, on which the hypocenter is located, has dimensions of 55 km × 25 km, segment 1-b and 1-c along the EAF expand over 90 km × 25 km, and 80 km × 25 km, respectively, whereas the southernmost segment 1-d covers an area of 140 km × 25 km (Fig. 4). In total, the four fault segments form a 365 km long rupture plane that extends to 25 km depth, parameterized by 365 subfaults.

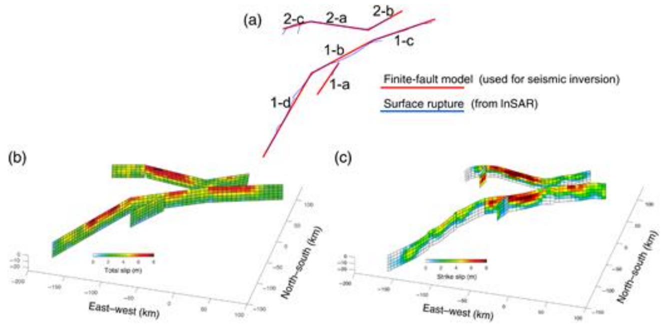


Figure 4. Finite-fault rupture models for the two Kahramanmaraş earthquakes. (a) Fault traces used for finite-fault inversion (map view), with numbered main segments used in the teleseismic-data inversion. (b) Final slip model from teleseismic data, color coded by total-slip magnitude (in meters). The red color saturates at 8 m with the maximum of 8.33 m. (c) Final slip model from geodetic data using the same color code as in panel (b); the maximum slip value is 8.85 m. We remark that our slip distributions are very consistent with those by Melgar *et al.* (2023) and Barbot *et al.* (2023).

For the 2nd mainshock, we discretized the fault rupture model into three segments, each subdivided into 5 km × 5 km subfaults. Segment 2-a, on which rupture nucleated, spans 70 km length; segment 2-b (to the east) and segment 2-c (to the west) are 70 km and 50 km long, respectively (Fig. 4a). Each segment extends for 25 km along the fault-dip direction (78° dip angle). The assumed rupture plane is thus 190 km long.

On each subfault, we solved for slip, rupture onset time, and rise time. Furthermore, we allowed for variable rupture velocity, searching in the range of 2.5–4.0 km/s. The local source time function was set to a half cosine; the slip direction (rake angle) was allowed to vary in the range −90° to 90° with respect to a reference rake angle of 0° (parallel to the strike direction).

Figure 4 summarizes the finite-fault rupture models inverted from coseismic surface displacements and teleseismic *P*-wave data. We did not perform any joint inversion, so each model is constrained by a single dataset. However, both the models reveal consistent slip distributions. The first *M*w 7.8 earthquake is characterized by three main areas of fault slip, showing up to 7 m of slip near the surface on segment 1-b, up to 6 m on segment 1-c, and 4–7 m on segment 1-d (in which we find the largest difference between the seismic and the geodetic models). Segment 1-a, on which the rupture started, had less fault slip but still up to ~3 m (Fig. S4c). The southernmost segment 1-d shows an area of high slip before rupture abruptly stops, in agreement with the backprojection results, creating a strong stopping phase. Together with rupture directivity along this 140 km fault segment, strong seismic radiation was generated toward the south into the Hatay-Antakia region that combined with local site effects, created severe local shaking and extensive damage. The total finite-fault seismic moment for this rupture models is 1.03×10^{21} N·m (□*M*w 7.97) and 6.13×10^{20} N·m (□*M*w 7.84) from the teleseismic and geodetic data, respectively consistent with other estimates (i.e., Jiang *et al.*, 2023).

The backprojection imaging and teleseismic source inversion thus reveal a "T-Bone" geometry with rupture propagating backward relative to the initial direction, seen only in few previous cases, that is, Kaikoura (Klinger *et al.*, 2018), Romanche (Hicks *et al.*, 2020), and to a lesser extent Landers event (e.g., Fliss *et al.*, 2005; Wollherr *et al.*, 2019).

Finite rupture models of the second mainshock show very large near-surface fault slip with the maximum slip exceeding 8 m on segment 2-a (on which rupture nucleated, see Fig. S5c) along the Sürgü fault, with slip values reaching 6 m over an extended stretch along that segment. Slip values then decreased toward northeast and southwest along segments 2-b and 2-c, respectively. These inferred slip values are in good agreement with surface displacement derived from geodetic data (Fig. 2). The inferred seismic moment of this rupture model is 5.03×10^{20} N·m (□*M*w 7.77) and 3.32×10^{20} N·m (□*M*w 7.65) for the seismic and geodetic model, respectively.

Ground-Motion Observations and Shaking Levels

We collected strong-motion recordings from the AFAD (see Data and Resources) for first *M*w 7.8 earthquake at 254 stations based on the following selection criteria: (1) instrument response removed, band-pass filter applied (low cutoff frequency: 0.025–0.1 Hz and high cutoff frequency: 25–40 Hz), and baseline corrected; (2) no abnormal recordings (e.g., no pre-event signals and no obvious peaks); (3) three-component recordings available; and (4) *VS*30 values available. Moreover, we obtained regional-distance seismic waveforms from several sites located along the southward extension of the EAF, the Dead Sea fault, and the Gulf of Aqaba, including stations in Saudi Arabia. We removed the instrument response from waveforms, and then filtered them between 0.01 and 50 Hz.

Figure 5 presents an overview of locations of strong-motion sites (Fig. 5a), selected examples of near-source recordings that illustrate pulse-like motions due to directivity effects and long-duration shaking (Fig. 5b), as well as regional-scale waveforms with well-developed surface waves (Fig. 5c). The peak ground acceleration (PGA) ShakeMap in Figure 5a documents PGAs exceeding 0.5*g* in mainly three areas: near Adiyaman, around the wider epicentral region, and over a large area in the Hatay-Antakia region. Locally, PGA values reached 1*g*, with one site (TK4614) even showing ~2*g* horizontal ground acceleration. In addition, we collected strong-motion recordings from 150 stations for the second mainshock, applying the same criteria as for the first event. First-order analysis of PGA values of the second event reveals overall lower ground motions (the maximum recorded PGA 0.56*g* at site TK4612, the closest to the epicenter at ~67 km distance; Fig. S12a). However, due to the lack of stations closer to the fault, even higher shaking levels may have occurred but were not recorded.

We further compared observations with two empirical ground-motion models (GMM) used in the 2018 Turkish probabilistic seismic hazard assessment (PSHA; Akkar *et al.*, 2018) (Figs. S6–S11). Whereas the first GMM is specific for Türkiye (Akkar and Çağnan, 2010), the second one applies to Europe and the Middle East (Akkar*et al.*, 2014). Our preliminary analyses suggested that observed ground motions exceed median GMM predictions not only for these two GMMs, both for "raw" observations, and if site-specific corrections for *VS*30 -based site amplification are applied (Figs. S7, S9, and S11). These observations are consistent with Gülerce *et al.* (2016) who modified the Next Generation Attenuation-West1 (NGA-W1) GMMs using the Turkish strong-motion database (so-called "TR-adjusted models"). These TR-adjusted GMMs better replicate recorded ground motions, because they adopted the well-constrained large-magnitude scaling of the global dataset in the NGA-W1 models. ShakeMaps for two spectral periods (T = 0.2 s and T = 1.0 s) of spectral acceleration SA(T) reveal the concentrated strong shaking in several areas (Fig. S13a–d). The regions of particularly high shaking levels correspond approximately to fault areas with high slip, whereby extended strong shaking in the Hatay-Antakia region can be explained by a combination of strong seismic radiation and local site effects. At several sites (e.g., Antakia, Iskenderun, and Arsuz), spectral accelerations exceeded the current building code of Türkiye (TBEC-18) at periods T >1 s relevant for tall structures (Figs. S13e,f).

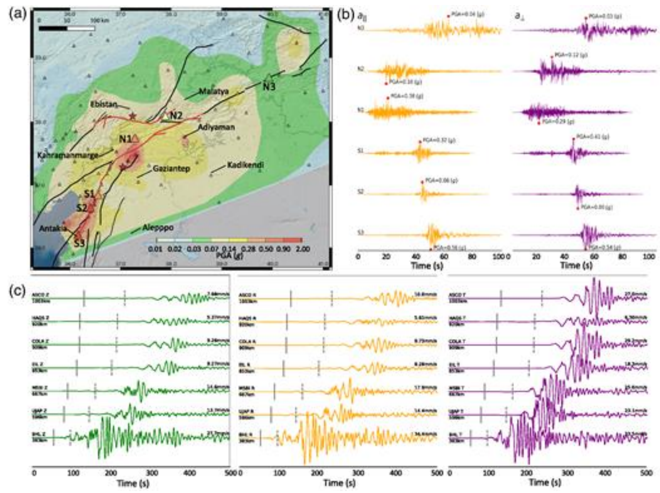


Figure 5. Ground-motion observations at local and regional scales for the *M*w 7.8 earthquake. (a) Spatially interpolated geometric mean of the peak ground acceleration for the fault-parallel and normal components. Triangles represent local strong ground-motion seismic stations. (b) Strong-motion (acceleration) waveforms rotated into fault-parallel (left column) and fault-perpendicular direction with respect to the fault strike (right column). Station symbols S1–S3 and N1–N3 on the map in panel (a) are shown to the left of each waveform. (c) Broadband three-component velocity waveforms from stations with azimuth from the source of about 193° (along the Dead Sea fault). Station names, components, and maximum amplitudes are shown to the left of each waveform; epicentral distances are shown on the right side of the waveforms. Vertical lines mark *P* and *S* arrival times.

Discussion and Conclusions

We conducted a first-order analysis of the rupture process of the magnitude *M*w 7.8 and 7.6 earthquake doublet of 6 February 2023 in south-central Türkiye using both satellite and seismic data. Both earthquakes are large, predominantly bilateral strike-slip ruptures. The *M*w 7.8 earthquake initiated on a side branch to the EAF and transitioned onto the main EAF with bilateral rupture into the northeast and southwest directions. Although the event stopped abruptly in the northeast (after ~55 s), rupture continued to the south where it then terminated after ~80 s. Directivity effects due to rupture propagation along extended straight fault segments as well as stopping phases due to sudden rupture cessation at fault extremities led to locally strong seismic radiation for the *M*w 7.8 earthquake. The *M*w 7.6 earthquake initiated on the Sürgü fault, which is 90 km north of the *M*w 7.8 epicenter and ruptured bilaterally for about 150 km. Given its magnitude, the *M*w 7.6 rupture is shorter and more compact. Considering the length of both ruptures and their strike-slip mechanisms, supershear rupture propagation may locally be expected. We found evidence for such behavior in the backprojection imaging for *M*w 7.6 event, but refined analyses based on strong-motion records is needed to confirm this initial observation.

PGAs during the *M*w 7.8 earthquake locally reached 2*g* and exceeded 0.5*g* over a wide area in the Hatay-Antakia region. Directivity effects and strong stopping phases are partially responsible for the observed strong-motion characteristics. Site effects further amplified ground motions locally. An initial analysis reveals that shaking levels exceeded median predictions from GMMs used in the most recent regional PSHA (Figs. S6–S11). Locally, observed spectral accelerations exceeded the design spectra of the current building code (Figs. S12a and S13). Ground motions of the second mainshock then hit already weakened or partially collapsed buildings and infrastructure, further increasing damage and destruction. In combination, these effects may provide partial explanations for the widespread damage and large destruction of these two earthquakes.

Although the occurrence of two such large earthquakes as a "doublet" is uncommon, the second event can be physically explained by stress changes in its epicentral area imposed by the first mainshock that brought the fault closer to failure (Stein *et al.*, 2023). Given size and location, we consider the *M*w 7.6 earthquake therefore a second mainshock and not an unusually large aftershock. Large strike-slip earthquakes like the *M*w 7.8 and 7.6 ruptures of 6 February 2023 are rare but not uncommon, because they have been observed in the past. Such multisegment ruptures forming "compounded" events on geometrically complicated fault structures are a challenge in standard PSHA.

Data and Resources

Real-time aftershock locations are provided by the Disaster and Emergency Management Authority (AFAD) available at https://deprem.afad.gov.tr/event-catalog. Focal mechanism solutions of the two mainshocks are available at https://geofon.gfz-potsdam.de/old/eqinfo/list.php?mode=mt. Focal mechanisms of significant seismicity during the period 1 January 2018–6 February 2023 can be downloaded at https://www.globalcmt.org/. Satellite data are available via the Sentinel data hub at https://scihub.copernicus.eu. Teleseimic waveforms for backprojection were downloaded from the Incorporated Research Institutions for Seismology (IRIS) at https://ds.iris.edu/wilber3/find_stations/11654089 for the *M*w 7.8 event and https://ds.iris.edu/wilber3/find_stations/11654205 for the *M*w 7.6 event. Teleseismic waveforms for finite-fault inversion were obtained from the IRIS at https://www.iris.edu, Geoforschungsnetz (GEOFON) at https://geofon.gfz-potsdam.de, and Observatories and Research Facilities for European Seismology (ORFEUS) at https://www.orfeus-eu.org data centers, respectively. Broadband waveforms of Figure 5 are from King Abdullah University of Science and Technology (KAUST) seismic network (COLA, ASCO, available upon request to the authors), GEOFON (EIL, MSBI, and UJAP) available at https://geofon.gfz-potsdam.de, and Lebanese Centre National de la Recherche Scientifique-École Normale Supérieure (CNRS; BHL, available upon request to the authors). Strong-motion data are available at https://tadas.afad.gov.tr/event-detail/15499. The 2018 seismic hazard map of Türkiye is available at https://www.resmigazete.gov.tr/eskiler/2018/03/20180318M1-2-1.pdf. High-resolution aftershock locations are available at "A. Lomax (2023). *Precise, NLL-SSST-coherence hypocenter catalog for the 2023 Mw 7.8 and Mw 7.6 SE Turkey earthquake sequence. (v2.0) [Data set]. Zenodo*, doi: 10.5281/zenodo.7727678". The supplemental material provides additional material to explain results and support discussions in the main paper. Specifically, the supplemental material includes figures on the processing of Sentinel-1 radar images, further information on the teleseismic back-projection and finite-fault inversions, and detailed comparisons of the observed ground motions with empirical ground-motion models and the design spectra of the Turkish building code. All websites were last accessed in February 2023.

Declaration of Competing Interests

The authors acknowledge that there are no conflicts of interest recorded.

Acknowledgments

We share with all our hearts the suffering of the citizens of Türkiye and Syria during these difficult days. Our condolences to all those affected by these devastating earthquakes, who lost their families, friends, neighbors, homes, and belongings.

We are indebted to the Saudi Geological Survey (SGS) and the National Center for Geophysics from Centre National de la Recherche Scientifique-École Normale Supérieure (CNRS) of Lebanon for sharing regional distance seismic waveforms. Comments and constructive criticism by two anonymous reviewers and the Associate Editor helped to improve our work. The research presented in this article is supported by King Abdullah University of Science and Technology (KAUST) in Thuwal, Saudi Arabia, by Research Grant Numbers BAS/1/1339-01-01 and BAS/1/1353-01-01.

Supplementary data

tsr-2023007_supplement- pdf file

The Seismic Record (2023) 3 (2): 105–115, https://doi.org/10.1785/0320230007

(GeoScienceWorld / The Seismic Record, May 04, 2023, https://pubs.geoscienceworld.org/ssa/tsr/article/3/2/105/623200/The-Destructive-Earthquake-Doublet-of-6-February)

Next steps in seismic hazard reduction after the Turkey earthquakes

Rebecca Owen

A new study offers insights, warnings and recommendations for moving forward from the recent devastation that followed the Feb. 2023 Turkey earthquakes.

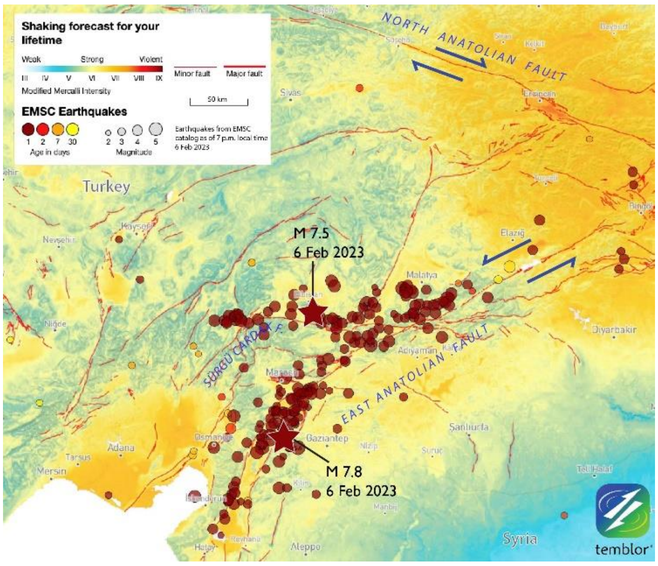
In February 2023, Turkey and Syria experienced two powerful earthquakes — the first, a magnitude-7.8 and second, a magnitude-7.5 event — just nine hours apart. More than 50,000 people were killed and cities were leveled.

As the region reels from the devastation, researchers are grappling with questions about protecting vulnerable areas and infrastructure to prevent future deaths in this seismically active location. A recent commentary in Nature Communications Earth and Environment revisited the effects of these quakes in both Turkey and Syria, and outlined the need to reassess hazards and risk in this region to protect people from future tragedy.

A pair of unusual earthquakes

At 4:17 a.m. on Feb. 6, 2023, most people in southeastern Turkey were asleep when the shaking began, causing buildings to collapse throughout the densely populated area. Nine hours later, the second quake amplified the unfolding humanitarian crisis. Buildings that were damaged in the first quake fell or were rendered more unstable. As a result, millions of people in Turkey and Syria have been displaced. This pair of earthquakes ranks as the fifth deadliest in the 21st century.

This region is well-known for its seismicity, having experienced several large earthquakes in the past. The East Anatolian Fault Zone forms the boundary between the Anatolian Plate and the northern tip of the Arabian Plate. A location like this one boasts abundant natural resources, like water and fertile growing regions. But, it also has active fault zones and plate movements that can disrupt population centers and industry if an earthquake occurs. This confluence of cities and seismic activity makes it all the more necessary to understand the potential hazards and to work quickly to prevent future damage and loss when large earthquakes occur.



The East Anatolian Fault hosted the first of two major earthquakes that struck Turkey in Feb. 2023. The Sürgü-Çardak fault ruptured about 9 hours later. Credit: Temblor, CC BY-NC-ND 4.0

Historically, earthquakes along the East Anatolian Fault Zone have varied in magnitude, from moderate (magnitude 6 or greater) to large (greater than magnitude 7), and these past earthquakes ruptured separate parts of the fault. The February 2023 earthquake pair was different. Together, these earthquakes ruptured several segments of the East Anatolian Fault Zone, "leading to a larger slip than the deficit accumulated since the last large events," says Luca Dal Zilio, co-author of the recent article and a senior researcher at ETH Zurich. "This unusual behavior contributed to the unexpected magnitude and damage."

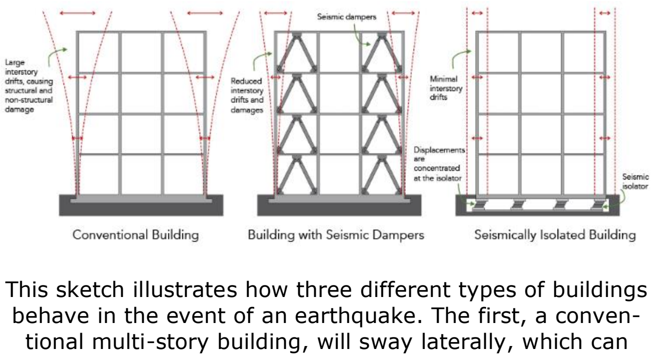
Dangerous buildings

In Syria, where the population is already extremely vulnerable due to ongoing war, structures may be built with substandard materials and design not suitable to withstand a large earthquake. But even in Turkey, more than 150,000 buildings collapsed or were damaged beyond repair. Originating in 1947 and last updated in 2018, Turkey's building codes address seismic concerns in the region, but these building specifications need to be followed and enforced in order to build earthquake resilience, writes Dal Zilio in the study.

One type of structure that was prone to collapse in Turkey was nonductile reinforced concrete buildings. These older buildings lack steel reinforcements that can keep them upright and prevent "pancaking" — where one story collapses onto the one below it. A second type of susceptible building was a "soft-story" building, says Osman Ozbulut, an associate professor of civil engineering at the University of Virginia who was not involved with the study. This type of building features a garage or open commercial space on the first level that has less support than the building's upper levels. Both older and newer soft-story buildings exhibited this sort of collapse.

"Buildings that were not up to date or designed and constructed with poor quality materials did not have a chance to survive this earthquake," says Ozbulut. "However, there are also many buildings — probably designed based on modern code requirements — that did not collapse but had heavy-to-moderate damage. Most of these buildings will now be demolished," he says.

Modern seismic building codes are intended to anticipate the damage done to buildings while still protecting their inhabitants after a strong earthquake. "This performance objective is called 'life safety," says Ozbulut. A building designed with life safety as its functional goal will sustain damage in a controlled manner and stay standing after an earthquake.



This sketch illustrates how three different types of buildings behave in the event of an earthquake. The first, a conventional multi-story building, will sway laterally, which can cause both structural and non-structural damage. The second type shows a building with seismic dampers, in which the swaying is dramatically reduced. The third type is a seismically isolated building. All movement is concentrated at the base, in the seismic isolator. Credit: Resilient and Advanced Infrastructure Laboratory (RAIL) at the University of Virginia, led by Ozbulut Osman

New Zealand's Christchurch earthquakes in 2010 and 2011 revealed the limits of building codes based on life safety requirements. Thousands of buildings designed with this modern code were damaged so extensively during the quakes that they had to be demolished, says Ozbulut.

After Christchurch, the engineering community was alarmed at the performance failures of modern buildings during these strong earthquakes. One design initiative to come from the destruction and loss in New Zealand was to build structures with functional recovery in mind. Functional recovery is when buildings are designed and constructed not only to protect inhabitants, but also to prevent damage and enable reoccupancy within an acceptable period of time after an earthquake, explains Ozbulut. Although different design strategies can be employed to achieve a higher performance objective, seismic protection technologies such as base isolation systems and seismic dampers can facilitate 'functional recovery' after a strong earthquake, he says.

Risk throughout the region

"The Turkey earthquake sequence is a serious alarm for developers to re-think about the acceptable risks during an earthquake," says Ozbulut. Other seismically active areas nearby, like the segment of the North Anatolian Fault system south of Istanbul that runs beneath the Marmara Sea, are also of concern. The Marmara Sea segment may be locked, and could potentially host a large magnitude event.

"People in Istanbul are also on high alert, newly reminded of the seismic hazard that looms over them, with the knowledge that buildings in the area may not be trustworthy," says Judith Hubbard, geologist and visiting assistant professor at Cornell University, who was not involved with the recent article.

The Dead Sea Fault system is another nearby concern, with a long historical record of infrequent but large earthquakes. A northern segment of this fault had three large earthquakes in the past 2,000 years between AD 100 and 750 and has now gone 850 years without a significant earthquake. Political and social turmoil in the region might make it difficult for necessary retrofitting and repair to ensure safer buildings before that next large event arrives. "After an earthquake there are always some international aid efforts, but the biggest payoff would be work before the next big earthquake," says Hubbard.

Reducing vulnerability and building resilience

To better prepare for future hazards, Dal Zilio has several suggestions to lessen the impact of future large quakes and aid in recovery: update and enforce building codes to make new construction perform better in a strong earthquake; prioritize the retrofitting of older buildings; launch public awareness campaigns to inform residents of how to protect themselves and their property; and improve emergency response services. Promoting hazard insurance — which is required in Turkey — might be another way to help residents recoup their losses and recover more quickly. Dal Zilio also suggests investing in more research for early warning systems, and encouraging collaborations among urban planners, seismologists and residents to build seismically safer cities.

"Understanding why some earthquakes are particularly devastating is important, but often earthquake science remains divorced from human impacts," says Hubbard. She adds that while earthquake science mostly focuses on understanding faults, "in the wake of a large earthquake, it is really important to think about why the science matters to people."

References

Dal Zilio, L., and Ampuero, J., 2023, Earthquake doublet in Turkey and Syria, Communications Earth & Environment, https://doi.org/10.1038/s43247-023-00747-z

Citation: Owen, R, 2023, Next steps in seismic hazard reduction after the Turkey earthquakes, Temblor, http://doi.org/10.32858/temblor.310

(May 12, 2023 by Temblor https://temblor.net/temblor/seismic-hazard-reduction-after-turkey-earthquakes-15298-15298/#disqus_thread)

"The underground space is often undervalued as an asset"
A conversation between Arnold Dix, President of ITA and Nikolaos Roussos, President of GTS

World Tunnel Congress 2023
"The underground space is often undervalued as an asset"

As the new edition of the WTC in Athens from 12 to 18 May approaches, Arnold Dix, President of the International Tunnelling and Underground Space Association and Nikolaos Roussos, President of the Greek Tunnelling Society, discuss several topics around tunnelling, its multiple challenges and the congress.

With the WTC approaching in May, what is the state of the tunnelling sector globally and particularly in Greece?

AD: Globally this sector has never been busier with major infrastructure being delivered as part of economic stimulus packages in many countries. Also the role of underground infrastructure in adaptive and resilient responses for the challenges posed by the changing climate has seen a boom in flood diversion, hydro power, sewerage and mountain transportation projects.

NR: We see this trend here in Greece and in Athens. Its underground network has expanded considerably in recent years and this development is now accelerating significantly. The Metro Line 3 Extension Project to Piraeus was successfully finished in October 2022, with the public opening of the final three new stations, Maniatika, Piraeus, and Dimotiko Theatro. The project, which included a 7.6 km long twin-track running tunnel, six new modern stations, and seven ventilation shafts, is one of the most significant expansions for the greater area of Athens and Piraeus region in decades.

Let's stay on the tunnelling activity in Greece and especially in Attica region. A major plan for the extension of the metro network in Athens is under discussion. Why are these projects essential?

NR: At this time, in Athens, a Metro network with over 110 stations is proposed, with 35 new stations in 9 extensions. After a decade of focusing Metro projects on the extension of Line 3 in Piraeus and the effort to begin the implementation of Line 4, new goals appear to be established for the coming years. The goal is to connect with other means, expand the network, and create new growth poles in the city, making Athens a friendlier city to its citizens and visitors.

Major plans for the extension of metro networks in big cities are essential for improving transportation, reducing congestion, promoting economic development, and enhancing urban mobility. These projects can have a significant positive impact on the lives of people in the city, making them a crucial investment for the future.

Sustainability in tunnelling and resilience against climate change. What's your view? Does the scarcity of urban space resources make the underground space planning de facto more sustainable?

AD: The threats posed to urban environments like climate change, tend to relate to less reliable surface assets like roads, railways, power distribution, and surface drainage, because more frequent, higher intensity storm events and more severe weather (such as heat or cold), tend to damage and render existing surface infrastructure compromised.

This then raises the prospect of more adaptive infrastructure of which the underground delivers many unique opportunities. The sustainability of such options depends partly upon the consequences of building and operating them on the climate emergency itself. Enormous improvements have been made to the environmental implications of building such infrastructure including low carbon materials and techniques.

NR: Moreover, tunnels can provide additional space for sustainable infrastructure such as underground water storage and renewable energy production.

Regarding the scarcity of urban space resources, yes, planning for the use of underground space can be considered more sustainable due to the limited availability of aboveground space in urban areas. By utilizing the underground space for transportation, utility corridors, and other infrastructure needs, it can help reduce the demand for aboveground space, which can help preserve green space and improve the overall liveability of urban areas.

Arnold Dix and Nikolaos Roussos

Precisely, the WTC 2023 will be under the sign of "Expanding Underground". Is the underground space undervalued as an asset?

NR: There is a significant amount that can be done below the surface of our cities, and the underground space is often undervalued as an asset. There are several reasons to explain that. Firstly, there is a lack of awareness and understanding of the potential uses and benefits of underground space. Many people may not realize that the underground space can be used for more than just transportation tunnels and utility tunnels.

Secondly, there are technical and logistical challenges associated with developing underground space. Excavating and constructing underground structures can be complex and costly, and requires specialized knowledge and equipment.

Thirdly, there may be regulatory and legal barriers to developing underground space. For example, there may be restrictions on the use of underground space in certain areas or limitations on the height or depth of structures that can be built.

AD: The area under cities is a spatial resource that is dimensionally limited but usually underutilised and undervalued.

There are enormous opportunities under most cities to augment the surface for greater human enjoyment and to deliver efficient and effective transportation, water, sewerage, energy, dangerous or confidential endeavours, strategic activities, and other complex human endeavours underground.

Sustainability in tunnelling and resilience against climate change. What's your view?

AD: The threats posed to urban environments like climate change, tend to relate to less reliable surface assets like roads, railways, power distribution, and surface drainage, because more frequent, higher intensity storm events and more severe weather (such as heat or cold), tend to damage and render existing surface infrastructure compromised.

NR: Tunnelling can help reduce the environmental impact of transportation by providing underground mass transit systems, which can reduce the need for individual cars and improve air quality. Additionally, tunnels can be used to provide underground utility corridors, which can reduce the need for overhead transmission lines and help protect against extreme weather events.

Regarding the scarcity of urban space resources, yes, planning for the use of underground space can be considered more sustainable due to the limited availability of aboveground space in urban areas. By utilizing the underground space for transportation, utility corridors, and other infrastructure needs, it can help reduce the demand for aboveground space, which can help preserve green space and improve the overall liveability of urban areas.

In conclusion, tunnelling can play an important role in promoting sustainability and resilience in the built environment, and the scarcity of urban space resources makes underground space planning an attractive option for meeting infrastructure needs. However, it is important to balance the potential benefits of underground development with the need for responsible planning and management to ensure that it is sustainable and does not have negative impacts on the environment or surrounding communities.

An extended version of this conversation will be available in the press kit of the WTC 2023.

Please find more information on the website: https://wtc2023.gr/

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

ΕΛΛΗΝΙΚΟΣ ΣΥΝΔΕΣΜΟΣ ΓΕΩΣΥΝΘΕΤΙΚΩΝ ΥΛΙΚΩΝ
HELLENIC GEOSYNTHETICS SOCIETY (HGS)

Ο Ελληνικός Σύνδεσμος Γεωσυνθετικών Υλικών (ΕΣΓΥ, IGS-Greece) διοργάνωσε την εκδήλωση με τίτλο "Γεωσυνθετικά για Όπλιση Εδάφους", στις 28/4/2023, στην Αθήνα (Αίθουσα Εκδηλώσεων ΤΕΕ). Προσκεκλημένος ομιλητής ήταν ο κ. Pietro Rimoldi, Πρόεδρος της Τεχνικής Επιτροπής της Διεθνούς Ένωσης Γεωσυνθετικών (IGS) για Ενίσχυση με Γεωσυνθετικά Υλικά (TC-R). Στο περιθώριο της εκδήλωσης, τιμήθηκαν για την προσφορά τους οι προηγούμενοι πρόεδροι του συνδέσμου, κκ. Δ. Ατματζίδης, Ομότιμος Καθηγητής Παν. Πατρών και Δρ. Αν. Κολλιός.

Υποδοχή και εγγραφή συμμετεχόντων

Διάλεξη «Γεωσυνθετικά για Όπλιση Εδάφους» από τον κ. P. Rimoldi

Τη διάλεξη παρακολούθησαν πέραν των 60 εγγεγραμμένων συμμετεχόντων. Τα βασικά θέματα που καλύφθηκαν αφορούσαν την αναθεώρηση του Ευρωκώδικα EN 1997-3, Κεφάλαιο 9, Κατασκευές οπλισμένων επιχώσεων, τις αρχές σχεδιασμού οπλισμένων επιχωμάτων, τοίχων οπλισμένης γης και ακροβάθρων γεφυρών, τον σχεδιασμό οπλισμένων βάσεων και στρώσεων επικάλυψης ΧΥΤΑ, ενώ παρουσιάστηκαν παραδείγματα εφαρμογών σε έργα και αναφορές σχετικά με τη βιωσιμότητα των κατασκευών οπλισμένων επιχώσεων, νέες εφαρμογές (επιχώματα προστασίας έναντι βραχοπτώσεων) και την ανάλυση αξιοπιστίας τοίχων οπλισμένης γης.

Βράβευση Ομ. Καθ. Δ. Ατματζίδη από τον Πρόεδρο του ΕΣΓΥ, Καθ. Ι. Μάρκου

Βράβευση Δρ. Αν. Κολλιού από τον Αντιπρόεδρο του ΕΣΓΥ, κ. Απ. Ρίτσο

Το Διοικητικό Συμβούλιο του ΕΣΓΥ με τον κ. P. Rimoldi και τους προηγούμενους Προέδρους του

Εκπαιδευτική Εκδρομή Φοιτητών Εργαστηρίου Εδαφομηχανικής, Θεμελιώσεων και Γεωτεχνικής Σεισμικής Μηχανικής του Τομέα Γεωτεχνικής Μηχανικής του Τμήματος Πολιτικών Μηχανικών ΑΠΘ στην Αθήνα

Το Εργαστήριο Εδαφομηχανικής, Θεμελιώσεων και Γεωτεχνικής Σεισμικής Μηχανικής του Τομέα Γεωτεχνικής Μηχανικής του Τμήματος Πολιτικών Μηχανικών ΑΠΘ οργάνωσε εκπαιδευτική εκδρομή στην Αθήνα στις 11-13 Μαΐου 2023 για τους φοιτητές του 3^{ου} και 4^{ου} έτους. Στο πλαίσιο των μαθημάτων "Εδαφομηχανική ΙΙ" και "Θεμελιώσεις, Αντιστηρίξεις και Γεωτεχνικά Έργα", πραγματοποιήθηκαν επισκέψεις στα εργοτάξια της ΑΤΤΙΚΟ ΜΕΤΡΟ στην Κατεχάκη και στο ΓΝΑ στη νέα γραμμή 4 του Μετρό της Αθήνας, σε ένα εργοτάξιο βαθιάς εκσκαφής και αντιστήριξης της REDEX στο Μαρούσι, και στο εργοτάξιο του Riviera Tower στο Ελληνικό.

Οι φοιτητές μας είχαν την ευκαιρία να δούνε από κοντά μεγάλα γεωτεχνικά έργα, όπως τα βαθιά φρέατα του Μετρό, βαθιές εκσκαφές, έργα αντιστήριξης και βαθιές θεμελιώσεις.

Ευχαριστούμε θερμά την ΑΤΤΙΚΟ ΜΕΤΡΟ, την AVAX, τη REDEX, την HARIS P. LAMARIS & ASSOCIATES, την ΕΔΡΑΣΗ, την INTRAKAT και το Ellinikon Project για τη φιλοξενία και τη διάθεση να ξεναγήσουν τους φοιτητές μας στα υπό κατασκευή έργα τους.

Κωνσταντίνος Γεωργιάδης
Καθηγητής Πολυτεχνικής Σχολής ΑΠΘ

Δημήτριος Πιτιλάκης
Αναπληρωτής Καθηγητής Πολυτεχνικής Σχολής ΑΠΘ

Εκπαιδευτική Εκδρομή Φοιτητών Κατεύθυνσης Γεωτεχνολογίας Σχολής Μεταλλειολόγων Μεταλλουργών Μηχανικών ΕΜΠ

Πραγματοποιήθηκε για μια ακόμα χρονιά η Τριήμερη Εκπαιδευτική Εκδρομή με τους Φοιτητές της Κατεύθυνσης Γεωτεχνολογίας της Σχολής Μεταλλειολόγων Μεταλλουργών Μηχανικών – ΕΜΠ.

Πλήθος στάσεων σε αξιόλογα τεχνικά έργα και σε ενδιαφέροντα γεωλογικά φαινόμενα.

- Λεκάνη Κωπαΐδας,
- Σήραγγα Κνημίδας και Ρήγμα Αγίου Κωνσταντίνου,
- Οπλισμένα Επιχώματα στον Ε65 – Ξυνιάδα
- Εδαφικές Υποχωρήσεις Δυτικού Θεσσαλικού Κάμπου
- Κατολίσθηση Ρωπωτού Τρικάλων
- Ασφαλτικά, Ε36 - Τμήμα Τρίκαλα - Μύκανη
- Ανατίναξη Ορύγματος, Ε36 - Τμήμα Τρίκαλα – Μύκανη
- Cut and Cover, Ε36 - Τμήμα Τρίκαλα – Μύκανη
- Σήραγγες Σιταρά, Ε36 - Τμήμα Μύκανη – Γρεβενά

- Ανάργυροι, Αμύνταιο, Εδαφικές Υποχωρήσεις
- Κατολίσθηση Ορυχείου Αμυνταίου
- Βαλτόνερα, Αμύνταιο, Εδαφικές Υποχωρήσεις
- Φράγμα Περδίκα, Πτολεμαΐδα
- Νίκη, Εδαφικές Υποχωρήσεις Ανατολικού Θεσσαλικού κάμπου

Τα έξοδα της εκδρομής καλύφθηκαν σε ποσοστό 100% από τις ευγενικές χορηγίες των εταιριών ΤΕΡΝΑ και Κονταξής ΑΤΕ και φυσικά και με την αρωγή του ΕΜΠ, το οποίο κάλυψε το μεγαλύτερο μέρος του κόστους του λεωφορείου.

Η εκδρομή δεν θα είχε επιτυχία χωρίς τη συμβολή του συναδέλφου Πολιτικού Μηχανικού Σταύρου Ζουμπούλη, προϊσταμένου του εργοταξίου της ΤΕΡΝΑ, που συντόνισε την επίσκεψη στον Ε65. Επίσης καθοριστικής σημασίας ήταν και η συμβολή της εταιρίας EXTRACO SA με την πολύ ενδιαφέρουσα παρουσίαση της τεχνολογίας αιχμής στο πεδίο των ανατινάξεων καθώς και με την πραγματοποίηση επίδειξης παρουσία των φοιτητών μας.

Τα χαμόγελα των παιδιών μας η απόλυτη αποζημίωση μας!!!

Κωνσταντίνος Λουπασάκης
Επίκουρος Καθηγητής, Ε.Μ.Π.

International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News & Information Circular May 2023
www.issmge.org/news/issmge-news-and-information-circular-May-2023

1. ISSMGE HERITAGE TIME CAPSULE (HTC) UPDATE

The HTC contributions of the Sri Lankan Geotechnical Society and Technical Committee TC 307 Sustainability in Geotechnical Engineering are now available for viewing in Part A of the HTC (https://www.issmge.org/the-society/time-capsule/part-a).

The following two papers were added to the contributions for ISSMGE Past President, M. Jamiolkowski (Italy) in Part B of the HTC (https://www.issmge.org/the-society/time-capsule/part-b).

- Jamiolkowski, M., Ladd, C.C., Germaine, J.T., Lancellotta, R. (1985). New developments in field and laboratory testing of soils. 11th International Conference on Soil Mechanics and Foundation Engineering, San Francisco, California, USA, pp. 57-153.
- Jamiolkowski, M. (2001). The leaning tower of Pisa: End of an Odyssey. 15th International Conference on Soil Mechanics and Geotechnical Engineering, Istanbul, Turkey, pp. 2979- 2996

Part C of the HTC (https://www.issmge.org/the-society/time-capsule/part-c) now includes Discoverer reports from Choo Siung Chung, Malaysia, and Monica Löfman, Finland.

2. ISSMGE BULLETIN

The latest edition of the ISSMGE Bulletin (Volume 17, Issue 1, April 2023) is available from the website.

3. ISSMGE FOUNDATION

The next deadline for receipt of applications for awards from the ISSMGE Foundation is the 31st May 2023. Click here for further information on the ISSMGE Foundation.

4. CONFERENCES

Member Societies, Technical Committees, Sister Societies and related organisations may add their events directly to the ISSMGE Events database via the link + Submit Event at the top of the EVENTS page

For a complete listing of all ISSMGE and ISSMGE supported conferences, and full information on all events, including deadlines, please go to the Events page at https://www.issmge.org/events. For updated information please refer to that specific events website.

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

ISSMGE EVENTS

GEO-CONGRESS 2024 - 25-02-2024 - 28-02-2024 Fairmont Waterfront, Vancouver, BC, Canada; Language: English; Organiser: Geo-Institute of the American Society of Civil Engineering (G-I of ASCE); Contact person: ASCE registration; Email: registrations@asce.org; Website: https://www.geocongress.org/

NORDIC GEOTECHNICAL MEETING - NGM 2024 - 18-09-2024 - 20-09-2024 Lindholmen Science Park, Göteborg, Sweden; Language: English; Organiser: Swedish Geotechnical Society; Contact Information: Victoria Svahn; Address: Sveaborgsvägen 16; Email: info@sgf.net; Website: http://www.ngm2024.se;

XVIII AFRICAN REGIONAL CONFERENCE ON SOIL MECHANICS AND GEOTECHNICAL ENGINEERING - 06-10-2024 - 09-10-2024 Algiers, Algeria; Languages: English & French; Organiser: Algerian Geotechnical Society; Contact Information: Algeos; Address: USTHB, Faculty of Civil Engineering BP 32 El-Alia - Bab-Ezzouar; Phone: (213) 66130954 ; Fax: (213) 21247224 : Email: secretariat18ARC@algeos-dz.com; Website : https://algeos-dz.com/18ARC.html

5TH EUROPEAN CONFERENCE ON PHYSICAL MODELLING IN GEOTECHNICS - 02-10-2024 - 04-10-2024 Deltares, Delft, Netherlands; Language: English; Organiser: Deltares & Delft University of Technology; Contact person: Suzanne van Eekelen & Miguel Cabrera; Email: organisation.ecpmg24@gmail.com

5TH INTERNATIONAL CONFERENCE ON TRANSPORTATION GEOTECHNICS - 20-11-2024 - 22-11-2024 Sydney Masonic Centre, 66 Goulburn Street Sydney NSW 2000 Australia; Language: English; Organiser: UTS Transport Research Centre (https://www.uts.edu.au/research/transport-research-centre); Contact person: Dr Chamindi Jayasuriya; Address: 15 Broadway; Email: chamindijayasuriya@gmail.com; Website: http://www.ictg2024.com.au; Email: Cholachat.Rujikiatkamjorn@uts.edu.au

NON-ISSMGE EVENTS

DFI 48TH ANNUAL CONFERENCE ON DEEP FOUNDATIONS - 31-10-2023 - 03-11-2023 Seattle Convention Center, Seattle, United States; Language: English; Organiser: Deep Foundations Institute; Contact person: Theresa Engler; Address: 326 Lafayette Avenue; Phone: 9734234030; Fax: 9734234031; Email: tengler@dfi.org; Website: http://www.dfi.org/annual2023

International Society for Rock Mechanics and Rock Engineering

ISRM

News

https://www.isrm.net

1st SLRMES conference in Colombo, Sri Lanka - call for Abstracts - 2023-05-03

The Sri Lankan Rock Mechanics and Engineering Society (SLRMES) invites you to participate in the 1st SLRMES Conference on Rock Mechanics for Infrastructure and Geo-Resources Development to be held in Colombo, Sri Lanka during December 2-7, 2023.

Participants are invited to submit 1-2-page Abstracts on any rock mechanics/engineering topic related to the aforementioned theme. The deadline to receive the abstracts is May 31, 2023. Information on the conference and procedures to submit abstracts are given on the website: www.slrmes.org.

Click here for the Call for Abstracts flyer

2nd International Workshop on Complex Formations - 2023-05-04

The Italian Geotechnical Society (AGI) is organizing the 2nd International Workshop on Complex Formations, to take place on 9 May, at the Maxwell Conference Room at the Politecnico di Torino.

For registration contact: agi@associazionegeotecnica.it

Click here to see the Workshop flyer

42nd ISRM Online Lecture by Professor Antonio Bobet on June 22 - 2023-05-09

The 42nd ISRM online lecture will be delivered by Professor Antonio Bobet, from USA. The title of the lecture is "The Mechanics and Imaging of Slip along Frictional Discontinui-ties". It will be broadcasted on 22 June 2023, 10 A.M. GMT at https://isrm.net/page/show/1104.

4th European Rock Mechanics Debate "Two different tunnelling approaches: the New Austrian Tunnelling Method (NATM) and the Norwegian Method of Tunnelling (NMT)" on 19 June - 2023-05-22

The 4th European Rock Mechanics Debate with Wulf Schubert from Austria and Krishna Kanta Panthi from Norway will take place on the 19 June. The title is "Two different tunnelling approaches: the New Austrian Tunnelling Method (NATM) and the Norwegian Method of Tunnelling (NMT)".

You can download the flier and register at this link: https://bit.ly/isrmdebatejune23

Election of the ISRM Regional Vice Presidents 2023/2027 - 2023-05-30

The election of the ISRM Regional Vice Presidents for the term of office 2023/2027 will take place during the Council meeting to be held in Salzburg on 10 October 2023.

The nominations submitted are available in the link https://isrm.net/page/show/1209?tab=1671

Online Course of Slope Engineering on the ISRM website - 2023-05-30

The online Course of Slope Engineering is being produced by Professor Wu Shunchuan from Kunming University of Science and Technology, China.

Focusing on the stability of slope engineering, the course starts from the basic concept and theory of slope, and then introduces the influencing factors, calculation methods, treatment measures and engineering effect monitoring of slope stability. The course has 10 parts, with a total of 37 lectures and will gradually be uploaded on the ISRM website.

The first three parts in a total of 8 lectures are now available in link: https://isrm.net/page/show/1682

☙ ❧

Scooped by ITA-AITES #91, 2 May 2023

Ontario advancing contract for Yonge North Subway Extension | Canada

In just 77 days, Agra Metro Rail Project reached major milestone | India

Norwegian tunnel upgrades are underway

Thane-Borivli tunnel project on verge of taking off, two bidders shortlisted | India

First undersea tunnel opens in northeast China

Contractors selected to submit tunnelling bids for Saudi megaproject Neom's railway junction | Saudi Arabia

Gateway Tunnel project split into four parts to speed up construction | U.S.A.

Athens prepares for the World Tunnelling Congress | Greece

Underground Metro stations to get island platforms | India

The potential of water for thermal energy storage underground | Sweden

Scooped by ITA-AITES #92, 16 May 2023

Melbourne's West Gate Tunnel achieves final TBM breakthrough | Australia

Gateway Development Commission notes progress on Hudson Tunnel Project | United States of America

D.C. Metro's Yellow Line to return May 7 after bridge, tunnel project | United States of America

Toronto sewer project aimed at lowering risk of basement floods gets underway | Canada

Is the future of driving underground? Boring Company to expand Vegas Loop to 69 stations | United States of America

3rd tunnel under Bosporus in the works, set to open in 2028 | Türkiye

Portugal's Braga approves €5.2m for road tunnel modernisation

Gus Klados recalls his early Athens Metro TBM drive experiences

National Grid's record breaking cement free concrete pour | UK

NCRTC achieves another tunnel breakthrough | India

Scooped by ITA-AITES #93, 30 May 2023

Delhi Metro to monitor real-time condition of buildings during tunnelling work | India

Progress on Suburban Rail Loop (SRL) East in Glen Waverley | Australia

Milestone for Snowy 2.0 project as second tunnel excavated - International Water Power | Australia

Construction resumes for Bolivian tunnel link | Bolivia

New subway's second boring machine reaches Broadway-City Hall Station | Canada

Infrastructure Minister inspects works on Murriz tunnel | Albania

Thames Tideway marks secondary lining achievement | UK

A deep underground lab could hold key to habitability on Mars | UK

Preparatory work for Rs7.34 billion (83M€) Siddhababa tunnel project begins | Nepal

DL E&C wins bid for Namhae-Yeosu undersea tunnel project | South Korea

Mersey Tunnel closure plans as upgrade work to begin | UK

Agra Metro's TBM re-launched for Taj Mahal Station, marking a new milestone | India

☙ ❧

BTSYM Workshop In-Person

Low Carbon Sprayed Concrete – Maximising the Potential for Carbon Reduction

Speakers: Chris Peaston & Stuart Manning

Thursday 25th May 2023 at 15:30 to 17:30 hrs

BTSYM welcomes you to an in-person interactive workshop where the results of an innovative research based on spraying trials will be presented and discussed.

This work demonstrates the potential for the substitution of 70% of the typical CEM I (Portland Cement) content with slag (GGBS), while meeting typical industry standard sprayed concrete lining (SCL) specification performance criteria, achieving a 60% reduction in embodied carbon.

Workshop Agenda:

- Introduction to sprayed concrete
- Introduction to HS2 Innovation Team funded low carbon sprayed concrete (LCSC) project
- Project progress to full scale site production
- *Networking break*
- Embodied carbon content calculations in sprayed concrete
- Discussion & Close

INTERNATIONAL GEOSYNTHETICS SOCIETY

Webinar
Service Life of Geomembranes in Hydraulic Applications

Eric Blod

Technical Committees on Barrier Systems (TC-B) and Hydraulics (TC-H) Live Webinar - 31 May - IGS

About the webinar

With the global increase of population, management of water is becoming a critical concern in many regions of the world, as it affects all aspects of human life: drinking water, irrigation, as well as hydroelectricity and industrial demand. Hydraulic structures have historically been built to control water, using clay, concrete or roller-compacted bituminous materials as sealing materials. Some are still standing after centuries or even millenniums.

However, the number of failures recently observed on such structures suggests that the performance and durability of the materials that were used has been overestimated. On the other hand, attempts to use geomembranes as sealing layers in dams, canals and reservoirs have been made since their invention in the middle of the XXth century. After about 70 years, it is possible to observe the performance of various types of geosynthetics used in such structures. It is also possible to predict with reasonably good reliability their anticipated service life using both field and laboratory observations. It is shown that the service life of most geomembranes can easily exceed the typical design life of hydraulic structures, in exposed or covered applications.

About the speaker

Eric Blond is an independent consultant providing technical services to the geosynthetics and building materials industries. He is actively involved in several technical committees and associations. He is Chairman of the ASTM D35.10 Subcommittee on Geomembranes, Chairman of the Canadian Mirror Committee of ISO TC221, IGS Council Member, Chairman of the IGS Technical Committee on Hydraulic, and Secretary of the IGS North American Chapter, among others. Eric Blond is the author of over 100 technical papers, conferences and courses. He is a lecturer at École Polytechnique de Montréal where he introduces geosynthetics to undergraduate students, and the design of geosynthetic lining systems to graduate students. He also offers customized training to engineering companies. He is registered as a professional engineer in Quebec and Alberta.

Registration

Time zone 1: 31 May 2023, 22:00 EDT / 1June 2023, 2:00 UTC / 31 May 2023, 21:00 CDT / 1 June 2023, 12:00 AEST / 1 June2023, 4:00 CEST

Time Zone 2: 5 June 2023, 8:00 EDT / 5 June 2023,12:00 UTC / 5 June 2023, 7:00 CDT / 5 June 2023, 22:00 AEST / 5 June 2023,14:00 CEST

bimrocks.com

Lectures from the 2nd International Workshop on Complex Formations
Turin, Italy on May 9 2023

The 2nd International Workshop on Complex Formations was held on May 9 2023 at Turin, Italy. Attendance was good and the Program was excellent.

I gave two lectures, one of which surveyed the evolution of bimrocks and bimsoils over the last 30 years. The other lecture outlined some of the certainties and doubts that I have about characterizing bimrocks and bimsoils at site scales.

PDFs of six of the seven Lectures presented are now available at the bimrocks.com website (click on the image of the Workshop poster below)

https://bimrocks.com/lectures-from-the-2nd-international-workshop-on-complex-formations-turin-italy-on-may-9-2023/

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΤΕΧΝΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

Ο Νικόλαος Βλαχόπουλος Engineering Institute of Canada Fellow (FEIC)

The Engineering Institute of Canada (EIC), founded in 1887, is pleased to announce the winning recipients of its 2023 senior engineering awards and fellowship inductees. The senior awards of the EIC are the highest distinctions made by the Institute and are awarded to deserving members of its 14 constituent societies.

Six exceptional engineers are being awarded EIC's 2023 engineering medals in recognition of their outstanding achievements and service to the engineering profession. In addition, a total of 22 outstanding engineers will be inducted as 2023 EIC Fellows for their exceptional contributions to engineering in Canada.

2023 EIC FELLOWS
For excellence in engineering and services to the profession and society

…
Nicholas Vlachopoulos (CGS), Royal Military College of Canada, Kingston, ON
…

ღ ஐ

Ioannis Fikiris Vice-President of the ITA Executive Council

The 4th Vice-President of the ITA Executive Council has just been elected by the representatives of the Member Nations. Congrats Ioannis Fikiris!

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

UYAK 2023 5th International Underground Excavations Symposium and Exhibition Cities of the Future, Urban Tunnelling and Underground Excavations, 5-6-7 June 2023, Istanbul, Turkey, https://uyak.org.tr

17DECGE Danube – European Conference on Geotechnical Engineering, 7-9 June 2023, Bucharest, Romania, https://17decge.ro

SuperPile'23 Piling Design & Construction Conference, June 7-9, 2023, Atlanta, USA, www.dfi.org/superpile2023

3rd JTC1 Workshop on "Impact of global changes on landslide risk",7 – 10 June 2023, Oslo, Norway, https://jtc1-2023.com

RETC2023 Rapid Excavation and Tunneling Conference, June 11-14, 2023, Boston, USA, www.retc.org/index.cfm

ICOLD Annual Meeting 2023, 11th to 15th June 2023 Gothenburg, Sweden, https://icold-cigb2023.se

9th International Congress on Environmental Geotechnics Highlighting the role of Environmental Geotechnics in Addressing Global Grand Challenges, 25-28 June 2023, Chania, Crete island, Greece, www.iceg2022.org

DFHM8 TORINO 2023 8th International Conference on Debris Flow Hazard Mitigation, 26-29 June 2023, Torino, Italy, http://dfhm8.polito.it

NUMGE 2023 - Numerical Methods in Geotechnical Engineering 2023, 26 - 28 June 2023 Imperial College London, UK, www.imperial.ac.uk/numerical-methods-in-geotechnical-engineering

AFRICA 2023 - The Fourth International Conference and Exhibition on Water Storage and Hydropower Development for Africa, 10-12 July 2023, Lake Victoria, Uganda, www.hydropower-dams.com

GEO-RISK 2023 Advances in Theory and Innovation in Practice, July 23-26, Arlington, Virginia, USA, www.geo-risk.org

STPRFC 3rd Edition Short-Term Prediction of Rock Failure Competition August 2023, Taiyuan, China, alv-1001@163.com, zc-feng@163.com

S3: Slopes, Support and Stabilization Conference, August 8-10, 2023, Boston, USA, www.dfi.org/s32023

17ARC 17th Asian Regional Geotechnical Engineering Conference, 14-18 August 2023, Nur-Sultan, Kazakhstan, https://17arc.org

ISMLG 2023 – 4th International Symposium on Machine Learning & Big Data in Geoscience, 29 August - 1 September 2023, University College Cork, Ireland, www.ismlg2023.com

IS-PORTO 2023 8th International Symposium on Deformation Characteristics of Geomaterials, 3rd - 6th September 2023, Porto, Portugal, www.fe.up.pt/is-porto2023

6th Meeting of EWG Dams and Earthquakes Workshop on Case studies, September 5, 2023, Interlaken, Switzerland, guillaume.veylon@inrae.fr

12th ICOLD European Club Symposium "Role of dams and reservoirs in a successful energy transition", 5 to 8 September 2023, Interlakes, Switzerland, www.ecsymposium2023.ch

NGS 2023 10th Nordic Grouting Symposium, 11 - 13 September, 2023, Stockholm, Sweden www.ngs2023.se

SUT OSIG 9th International Conference "Innovative Geotechnologies for Energy Transition", 12-14 September 2023, London, UK, www.osig2023.com, www.sut.org

SAHC 2023 13th International Conference on Structural Analysis of Historical Constructions "Heritage conservation across boundaries", 12-15 September 2023, Kyoto, Japan, https://sahc2023.org/

TKZ2023 XX Technical Dam Control International Conference Safety of Hydraulic Structures, 12-15 September 2023, Chorzów Poland https://tkz.is.pw.edu.pl

The 11th International Conference on Scour and Erosion 17-21, September 2023, Copenhagen, Denmark, https://icse11.org

XII ICG - 12th International Conference on Geosynthetics, September 17 – 21, 2023, Rome, Italy, www.12icg-roma.org

GROUND ENGINEERING SUSTAINABILITY, 21 September 2023, London, U.K., https://sustainability.geplus.co.uk/sustainability/en/page/home

Charles-Augustin COULOMB : A geotechnical tribute, 25 – 26 September 2023, Paris, France, www.cfms-sols.org/organisees-par-le-cfms/charles-augustin-coulomb-geotechnical-tribute

GEOCASE 2023 International Conference on "Case Histories In Geotechnical Engineering" & 4th AsRTC6 Urban Geoengineering Symposium, September 25 - 28, 2023, Bandung, Indonesia, www.geocase2023.com

SEG23 Symposium on Energy Geotechnics, 3-5 October 2023, Delft, The Netherlands, https://seg23.dryfta.com

28th European Young Geotechnical Engineers Conference and Geogames
04 – 07 October 2023, Moscow, Russia

Organiser: Russian Society for Soil Mechanics, Geotechnics and Foundation Engineering

Contact person: PhD Ivan Luzin
Address: NR MSUCE, 26 Yaroslavskoye shosse
Phone: +7-495-287-4914 (2384)
Email: youngburo@gmail.com

GROUND ENGINEERING BASEMENTS AND UNDERGROUND STRUCTURES, 5 October 2023, London, U.K., https://basements.geplus.co.uk/basements2023/en/page/home

GROUND ENGINEERING SMART GEOTECHNICS, 5 October 2023, London, U.K., https://smartgeotechnics.geplus.co.uk/smartgeotechnics2023/en/page/home

MSL 2023 The Second Mediterranean Symposium on Landslides "Slope Stability in Stiff Fissured Clays and Soft Rocks", October 5-7, 2023, Hammamet, Tunisia, https://msl-2023.webnode.fr

2023 15th ISRM Congress, International Congress in Rock Mechanics Challenges in Rock Mechanics and Rock Engineering, 9÷14 October 2023, Salzburg, Austria, https://www.isrm2023.info/en/

HYDRO 2023 New Ideas for Proven Resources, 16-18 October 2023, Edinburgh, Scotland, www.hydropower-dams.com/hydro-2023

1-ICGTMW2023 1st International Conference on Geotechnics of Tailings and Mine Waste & GEOMIN 2023, 24th to 26th, October 2023, Ouro Preto, Minas Gerais, Brazil, https://geominouropreto.com.br/2023/icgtmw2023

SEAGC-AGSSEA 2023 21st Southeast Asian Geotechnical Conference & 4th AGSSEA Conference, 25th to 27th October 2023, Bangkok Thailand, https://seagcagssea2023.com

ACUUS SINGAPORE 2023 18th Conference of the Associated Research Centers for the Urban Underground Space "Underground Space – the Next Frontier", 1 - 4 Nov 2023, Singapore, www.acuus2023.com

ATC 2023 18th Australasian Tunnelling Conference: Trends and Transitions in Tunnelling, 5-8 November, 2023, Auckland, Aotearoa New Zealand https://atc2023.com

6th World Landslide Forum "Landslides Science for sustainaible development", 14 to 17 November 2023, Florence, Italy, https://wlf6.org

CREST 2023 – 2nd Construction Resources for Environmentally Sustainable Technologies, November 20-22, 2023, Fukuoka, Japan, https://www.ic-crest.com

1st SLRMES Conference on Rock Mechanics for Infrastructure and Geo-Resources Development - an ISRM Specialized Conference, Colombo, Sri Lanka, December 2 -7, 2023, www.slrmes.org

GEOTEC HANOI 2023 The 5th International Conference on Geotechnics for Sustainable Infrastructure Development, December 14-15, 2023 - Hanoi, Vietnam, https://geotechn.vn

9th International Symposium on RCC Dams and CMDs December, 2023, Guangzhou, China, www.chincold-smart.com/meetings/rcc2023

7th International Conference Series on Geotechnics, Civil Engineering and Structures (CIGOS)
April 4-5, 2024, Ho Chi Minh City, Vietnam

Organiser: Association of Vietnamese Scientists and Experts (AVSE Global) and University of Architecture Ho Chi Minh City (UAH)

Contact person: cigos2024@sciencesconf.org
Email: cigos2024@sciencesconf.org

World Tunnel Congress 2024 19 to 25, April, 2024, Shenzhen China, www.wtc2024.cn

iCGE'24 International Conference of Geotechnical Engineering, April 25-27, 2024, Hammamet, Tunisia www.icge24.com

GEO AMERICAS 2024 5th Pan-American Conference on Geosynthetics Connecting State of the Art to State of Practice April 28 – May 1, 2024, Toronto, Canada, www.geoamericas2024.org

IFCEE 2024 International Foundation Congress and Equipment Expo, May 7 –10, 2024, Dallas, USA https://web.cvent.com/event/c42dd622-dd91-409f-b249-2738e31c9ef5/summary

8th International Conference on Earthquake Geotechnical Engineering (8ICEGE), 7-10 May, 2024 Osaka, Japan, https://confit.atlas.jp/guide/event/icege8/top?lang=en

IS-Macau 2024 11th International Symposium of Geotechnical Aspects of Underground Construction in Soft Ground, June 14-17, 2024, Macao SAR, China, https://is-macau2024.skliotsc.um.edu.mo

ISC'7 7th International Conference on Geotechnical and Geophysical Site Characterization "Ground models, from big data to engineering judgement", June 18-21, 2024, Barcelona, Spain, https://isc7.cimne.com

WCEE2024 18th World Conference on Earthquake Engineering, June 30 - July 5, 2024, Milan, Italy, www.wcee2024.it

Session SHR-7:
When science meets industry:
advances in engineering seismology stemming from engineering practice

The challenges encountered in major industrial projects can provide a springboard for research and innovation, bringing about several advances in the Engineering and Seismological communities. In the US, it has long been the case that cutting-edge research in engineering seismology does not only originate in a purely academic context but also from practice in large-scale projects between academia and industry aimed at solving real case-specific challenges, not least in the domain of seismic hazard assessment. In more recent years, large national and international industrial projects in many other countries and continents have also begun to shape the state-of-the-art in science, technology and practice, developing new approaches and innovative techniques in several topics, including source processes, ground motion, hazard assessment and uncertainty, induced seismicity, earthquake engineering and design, and more.

This session aims to bring together the Engineering and Seismological communities and create a platform for discussion and exchange concerning recent advances in any aspect of engineering seismology where innovation in data, models or methods has been driven by the needs of industry. We welcome contributions from academics and practitioners, national bureau rendering expert services, organisations from the energy and other sectors, companies providing research-led consulting. We also seek to hear from those developing new products, sensors, tools or software that are changing the state-of-the-art and to discuss exciting new possibilities for applications.

Invited Speakers

J. Bommer, K.-F. Ma, S. Nikolaou, S. Bora, Z. Gulerce

Conveners

Olga-Joan Ktenidou, National Observatory of Athens, Greece
olga.ktenidou@gmail.com
Domniki Asimaki, CalTech, USA
Hiroe Miyake, ERI UTokyo, Japan

3rd ICPE 2024 Third International Conference on Press-in Engineering, 3-5 July 2023, Singapore, https://2024.icpe-ipa.org

IS Landslides 2024 International Symposium on Landslides "Landslides across the scales: from the fundamentals to engineering applications" & IS Rock Slope Stability 2024, July 7-12th, 2024, Chambéry, France, www.isl2024.com

EUROCK 2024 ISRM European Rock Mechanics Symposium New challenges in rock mechanics and rock engineering July 15-19, 2024, Alicante, Spain, www.eurock2024.com

ECSMGE 24 XVIII European Conference on Soil Mechanics and Geotechnical Engineering, 26-30 August 2024, Lisbon, Portugal, www.ecsmge-2024.com

ISIC 2024 4th International Conference of International Society for Intelligent Construction, 10 – 12 September 2024, Orlando, United States, www.is-ic.org/conferences/2024-isic-international-conference

IS-Grenoble 2024 Geomechanics from Micro to Macro, September 23-27, 2024, Grenoble, France, https://is-grenoble2024.sciencesconf.org

2024 ISRM International Symposium
24-28 September, New Delhi, India

Contact Person Name

Dr. Mahendra Singh or Mr. A.K. Dinkar

Email sunil@cbip.org; secretary@cbip.org; msingh.civil@gmail.corn

Telephone +91 11 26115984 or +91 11 26116567

Address Plot No. 4, Institutional Are4 CBIP Building Malcha Marg, Chanakyapuri New Delhi - 110021 India

1st International Rock Mass Classification Conference
"Rock Mass Classification meets the Challenges of the 21st Century"
30-31 October 2024, Oslo, Norway
www.rmcc2024.com

Since the 1950s, the topic of rock mass classification was a central issue for geotechnical engineers and heated discussions amongst scholars up to international court cases revolve around it. The overall goal of the RMCC is therefore to provide an arena for the international rock mechanics community for knowledge development, interaction and sharing.

Today's society has an ever-increasing need for infrastructure to be internally connected as well as resilient against changing environments. This demand meets decreasing numbers of engineers due to demographic change and a paradigm shift towards digitalization. This makes the practicability of systems that rely on the subjective experience of engineers questionable. Furthermore, many of today's rock mass classification systems have been developed with a focus on economic optimization which yet again stands in contrast to today's requirements for sustainability and the need for a green transition to fight climate change. The RMCC 2024 should therefore discuss a decade old topic – rock mass classification – in the light of the challenges of the 2020s like demographic change, the green transition and digitalization.

Topics

- Comparing and correlating rock mass classification systems
- Today's rock mass classification systems in the light of sustainability, demographic change, digitalization, and open data
- Digital methods and modern technology for rock mass classification and characterization

- The future of rock mass classification – questioning the state of the art

Contact

office.rmcc2024@ngi.no

☙ ❧

PANAMGEO CHILE 2024 17th Pan-American Conference on Soil Mechanics and Geotechnical Engineering, 12-17 November 2024, La Serena, Chile, https://panamge-ochile2024.cl

ICTG 2024 5th International Conference on Transportation Geotechnics 2024 "Sustainable and Evolving Technologies for Urban Transport Infrastructure", 20 – 22 November 2024, Sydney, Australia www.ictg2024.com.au

☙ ❧

Eurock 2025
ISRM European Rock Mechanics Symposium
Expanding the underground space - future development of the subsurface - an ISRM Regional Symposium
16–20 June 2025, Trondheim, Norway

Contact Person Name

Henki Ødegaard
Email henki.oedegaard@multiconsult.no
Telephone +47 22 94 75 00
Address C/O Fredrik Stray, TEKNA, PO box 2312 Solli, Oslo, Norway

☙ ❧

21st International Conference on Soil Mechanics and Geotechnical Engineering
14 – 19 June 2026, Vienna, Austria

Organisers:

Austrian Geotechnical Society and Austrian Society for Geomechanics

Contact person: Prof. Helmut F. Schweiger

Email: helmut.schweiger@tugraz.at

☙ ❧

16th International Congress on Rock Mechanics
Rock Mechanics and Rock Engineering Across the Borders
17-23 October 2027, Seoul, Korea

Scope

The scope of the Congress will cover both conventional and emerging topics in broadly-defined rock mechanics and rock engineering. The themes of the Congress include but not be limited to the following areas:

- Fundamental rock mechanics
- Laboratory and field testing and physical modeling of rock mass
- Analytical and numerical methods in rock mechanics and rock engineering
- Underground excavations in civil and mining engineering
- Slope stability for rock engineering
- Rock mechanics for environmental impact
- Sustainable development for energy and mineral resources
- Petroleum geomechanics
- Rock dynamics
- Coupled processes in rock mass
- Underground storage for petroleum, gas, CO2 and radioactive waste
- Rock mechanics for renewable energy resources
- Geomechanics for sustainable development of energy and mineral resources
- New frontiers & innovations of rock mechanics
- Artificial Intelligence, IoT, Big data and Mobile (AICBM) applications in rock mechanics
- Smart Mining and Digital Oil field for rock mechanics
- Rock Engineering as an appropriate technology
- Geomechanics and Rock Engineering for Official Development Assistance (ODA) program
- Rock mechanics as an interdisciplinary science and engineering
- Future of rock mechanics and geomechanics

Our motto for the congress is "Rock Mechanics and Rock Engineering Across the Borders". This logo embodies the interdisciplinary nature of rock mechanics and challenges of ISRM across all countries and generations.

The very large incipient rockslide at Brienz in Switzerland

In the Swiss canton of Graubünden, a village named Brienz (or Brinzauls) in the municipality of Albula/Alvra has been evacuated due to an incipient, large rockslide. The BBC has a good write up of the situation – the slope above the village, and indeed under the settlement itself, shown below, has been moving for many years, but has accelerated in recent months. Parts of the slope are reported to be moving at 32 metres per year, and the mobile volume is about 2 million m³.

The rockslide above Brienz in eastern Switzerland. Image by CHRISTOPH NÄNNI, TIEFBAUAMT GR, SWITZERLAND via the BBC.

Swissinfo has a more detailed description of the situation in the village:-

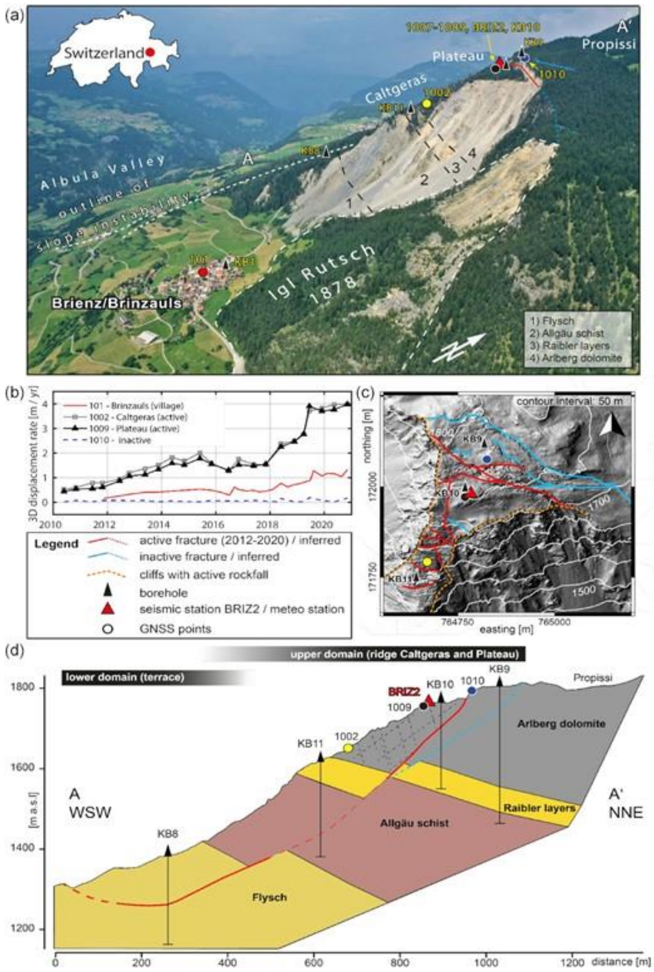
The municipality in canton Graubünden has activated the "orange phase" and therefore the evacuation of the village, which has a population of about 130.

As of Friday evening nobody will be allowed to stay overnight in the village until further notice. From Saturday villagers will be allowed into Brienz/Brinzauls during the day, if the danger level permits. Livestock from two farms will remain in the stables for the time being, the authorities said.

All access roads to Brienz/Brinzauls are now open only to residents and homeowners. On Tuesday evening the authorities will provide information on the details of the evacuation during a public information event in the nearby village of Tiefencastel.

The local authority has a detailed site dedicated to the rockslide (in German). It notes that the landslide, which includes the village itself, has been moving since the ice age, with movement rates of a few centimetres per year. It accelerated about 20 years ago, with movement rates until the current crisis of about a metre per year.

Some research on the landslide at Brienz has been published (Häusler *et al.* 2021), noting that the landslide is part of a much larger area of deep-seated gravitational slope deformation. The paper includes this image that summarises the setting of the landslide:-



Overview of the Brienz landslide by Häusler et al. (2021). Original caption: Overview of the deep-seated landslide at Brinzauls, with focus on the Plateau subdomain. (a) Photograph of the Brinzauls rock instability (view towards northwest) with drilling locations, GNSS (Global Navigation Satellite System) monitoring positions and seismometer location. (b) Displacement time-series at selected locations marked on panel (a). (c) Elevation model and simplified geomorphological map of the Plateau (see Fig. S1 for details). (d) Geological profile along the ridge Caltgeras. Photograph panel (a) by courtesy of SRF Einstein. Elevation model in panel (c) provided by courtesy of AWN. Coordinate frame LV03 (WGS84: 46.679, 9.593).

Predicting the short term behaviour of very large, complex landslides in extremely challenging, as was shown in the Mannen rockslide in Norway. That this slope will eventually fail is close to being certain, but when and exactly how is less clear. Those involved in Switzerland are doing a fine job of managing the risk and of keeping the public informed.

Acknowledgement

Thanks to Charles Hunt for highlighting this one to me.

Reference

Häusler, M., Gischig, V., Thöny, R., Glueer, F. and Donat, F. 2021. Monitoring the changing seismic site response of a fast-moving rockslide (Brienz/Brinzauls, Switzerland). *Geophysical Journal International*, **229** [1], 299–310, https://doi.org/10.1093/gji/ggab473

(Dave Petley / THE LANDSLIDE BLOG, 10 May 2023, https://blogs.agu.org/landslideblog/2023/05/10/brienz-rockslide-1)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ & ΑΝΤΙΣΕΙΣΜΙΚΗ ΜΗΧΑΝΙΚΗ

Seismic Source Zones for Site-Specific Probabilistic Seismic Hazard Analysis: The Very Real Questions Raised by Virtual Fault Ruptures

Julian J. Bommer; Jon P. Ake; Clifford G. Munson

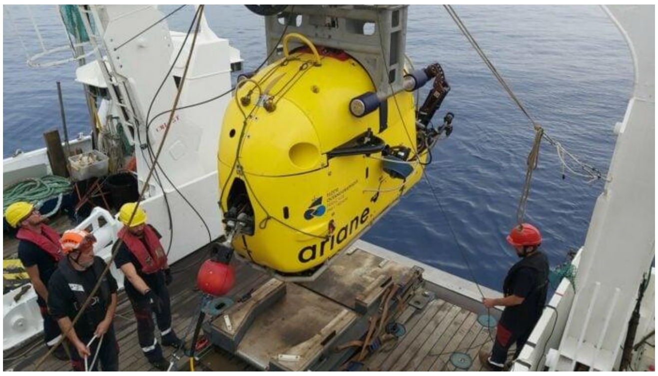
Abstract

Site-specific probabilistic seismic hazard analyses (PSHAs) very often include areal source zones to represent diffuse seismicity that cannot be associated with known geological faults. Most modern ground-motion prediction models use distance metrics that are defined relative to the extended fault rupture rather than the epicenter or hypocenter. For these distances to be calculated correctly, virtual fault ruptures are generated, having dimensions consistent with the earthquake magnitude, within source zones when performing PSHA calculations. Although the generation of these virtual ruptures is necessary to achieve compatibility between the seismic source and ground-motion models within the hazard calculations, the ruptures should, by definition, represent potentially realizable seismogenic structures within the crust. Frequently, algorithms for the generation of these virtual ruptures are embedded within the PSHA code as an interim calculation without generating any outputs to enable visualization of the location and extension of the resulting ruptures. Such visualizations can reveal features of these hypothetical ruptures that may challenge the assumptions underlying the definition of the source zone boundaries that separate and enclose distinct regions of diffuse seismicity, as well as raising questions regarding the recurrence parameters within each source, especially in terms of the assumed maximum magnitudes. Visualizing the virtual ruptures generated in PSHA calculations and ensuring their consistency with the criteria established, explicitly or otherwise, for the definition of seismic source zones, could lead to important improvements in the modeling of diffuse seismicity in PSHA. We propose that this visualization should become a standard step in any PSHA study that includes source zones of diffuse seismicity. In addition, the choice of strict or leaky source zone boundaries relative to these hypothetical ruptures should always be explained and justified rather than simply stated.

Seismological Research Letters (2023)
https://doi.org/10.1785/0220230037

https://pubs.geoscienceworld.org/ssa/srl/article-abstract/doi/10.1785/0220230037/623155/Seismic-Source-Zones-for-Site-Specific?redirectedFrom=fulltext

Ρομπότ μελετά τον ισχυρότερο σεισμό της Μεσογείου τα τελευταία 200 χρόνια που έγινε μεταξύ Αμοργού και Ανάφης



πηγή φωτό Paraskevi Nomikou

Συνέβη το 1956, είχε μέγεθος 7,5 Ρίχτερ και γνωρίζουμε ελάχιστα πράγματα για αυτόν.

Στις 9 Ιουλίου 1956 σημειώθηκε ένας πολύ ισχυρός και καταστροφικός σεισμός μεγέθους 7,5 Ρίχτερ, με επίκεντρο τη θαλάσσια περιοχή μεταξύ Αμοργού, Ανύδρου και Ανάφης. Τα περιορισμένα μέσα της εποχής είχαν ως αποτέλεσμα οι γνώσεις μας για τον σεισμό αυτό να είναι λίγες και ο ακριβής εντοπισμός του επίκεντρου, αδύνατος. Εξήντα επτά χρόνια μετά, μια διεθνής ωκεανογραφική αποστολή επιχειρεί να εντοπίσει, με τη βοήθεια εξελιγμένου ρομπότ, πληροφορίες για αυτόν τον ισχυρότερο σεισμό της Μεσογείου τα τελευταία 200 χρόνια.

Δεν ήταν μόνο ο κύριος σεισμός της 9ης Ιουλίου καταστροφικός. Τον διαδέχτηκε 13 λεπτά αργότερα ισχυρότατος μετασεισμός μεγέθους 7,2 Ρίχτερ κοντά στη Σαντορίνη, που προκάλεσε ζημιές και κόστισε πολλές ανθρώπινες ζωές. Επίσης, προκλήθηκε μεγάλο τσουνάμι που πλημμύρισε τις ακτές από τη Φολέγανδρο ως την Τουρκία, με τα κύματα να φτάνουν μέχρι και τα 20 μέτρα στην Αμοργό. Το επίκεντρο και τα ρήγματα του σεισμού δεν ήταν γνωστά και οι λίγες μελέτες που έγιναν τότε στην ξηρά και τη θάλασσα δεν αποκάλυψαν τι πραγματικά συνέβη.

Κατά τη διάρκεια προηγούμενων ωκεανογραφικών αποστολών έγιναν γεωφυσικές μελέτες, όπου αποτυπώθηκε η μορφολογία του υποθαλάσσιου πυθμένα ανάμεσα στη Σαντορίνη, την Αμοργό, την Ανάφη και την Αστυπάλαια και εντοπίστηκαν σε μέγιστο βάθος 750 μέτρων τρία υποθαλάσσια ρήγματα παράλληλα το ένα με το άλλο, σε απόσταση 70 χιλιομέτρων.

Μια διεθνής ομάδα εκτελεί υποθαλάσσιες έρευνες στην ίδια περιοχή τα τελευταία δύο χρόνια, για να ρίξει φως στον μηχανισμό που ενεργοποίησε τον καταστροφικό σεισμό και το επακόλουθο τσουνάμι. Στην ομάδα συμμετέχουν η αναπληρώτρια καθηγήτρια του Τμήματος Γεωλογίας και Γεωπεριβάλλοντος του Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών Εύη Νομικού, αλλά και επιστήμονες από ερευνητικά ιδρύματα της Γαλλίας, οι Φρεντερίκ Λεκλέρκ από το Πανεπιστήμιο Cote d' Azur, Ναταλί Φουγιέ από το ινστιτούτο Institut du Physique du Globe του Παρισιού και Χαβιέ Εσκαρτέν από τη Σχολή Ecole Normale Superieure de Paris.

Το υποθαλάσσιο ρήγμα της Αμοργού, εξηγεί η κ. Νομικού «είναι ένα από τα πιο ενεργά ρήγματα του ελληνικού θαλάσσιου χώρου και είναι σημαντικό να έχουμε στοιχεία για τη γεωμετρία του, αλλά και για πρώτη φορά οπτικά δεδομένα από τον "καθρέφτη" του ρήγματος, δηλαδή τη λεία επιφάνεια που δημιουργείται κατά τη μετακίνηση του εδάφους έπειτα από σεισμό. Ο στόχος μας είναι να κατανοήσουμε τον μηχανισμό γένεσης του σεισμού του 1956 και του τσουνάμι που προκλή-θηκε».

Ένα ρομπότ, πολύτιμος βοηθός

Πολύτιμος βοηθός στην έρευνά τους είναι το ρομποτικό όχημα Ariane, το οποίο έχει τη δυνατότητα να καταδυθεί σε βάθος μέχρι 2.500 μέτρα και να παραμείνει εκεί έως και έξι ώρες σε κάθε κατάδυση. Οι 4K κάμερες που διαθέτει καταγράφουν τη μορφολογία του υποθαλάσσιου πυθμένα και επιτρέπουν στους ερευνητές να δουν και να μελετήσουν το ανάγλυφο με μέγιστη ταχύτητα τα 0,5 μέτρα ανά δευτερόλεπτο. Εξοπλισμένο με δύο μηχανικούς βραχίονες, είναι επίσης σε θέση να συλλέξει ιζήματα σε σωλήνες μήκους 30 εκατοστών που ονομάζονται πυρήνες. Οι οκτώ πυρήνες με ιζήματα που συλλέχθηκαν θα βοηθήσουν στη χρονολόγηση του υποθαλάσσιου αναγλύφου.

Για τις ανάγκες της έρευνας, το Ariane καταδύθηκε εννιά φορές για συνολικά 26 ώρες και διένυσε συνολικά 13 χιλιόμετρα εξερευνώντας τη ζώνη του ρήγματος της Αμοργού και των άλλων ρηγμάτων. Τράβηξε χιλιάδες φωτογραφίες, οι οποίες θα χρησιμοποιηθούν για την παραγωγή τρισδιάστατων μοντέλων που θα βοηθήσουν τους επιστήμονες να μετρήσουν την παραμόρφωση του θαλάσσιου πυθμένα.

Επιπλέον, στις έρευνες συμμετείχε και το γαλλικό ωκεανογραφικό πλοίο «L' Europe», που είναι εξοπλισμένο με πολυδεσμικό σύστημα χαρτογράφησης για την καταγραφή της υποθαλάσσιας μορφολογίας σε παράκτιες περιοχές. Κατά τη διάρκεια της νύχτας αλλά και τις μέρες που επικρατούσαν θυελλώδεις άνεμοι που εμπόδιζαν το ρομποτικό σκάφος να καταδυθεί, το «L' Europe» συγκέντρωσε βαθυμετρικά δεδομένα στην παράκτια ζώνη της Ανάφης και της Αμοργού. Τα υψηλής ανάλυσης βαθυμετρικά δεδομένα θα χρησιμοποιηθούν στη μοντελοποίηση της διάδοσης του τσουνάμι του 1956, προκειμένου να κατανοηθεί καλύτερα ο μηχανισμός δημιουργίας του.

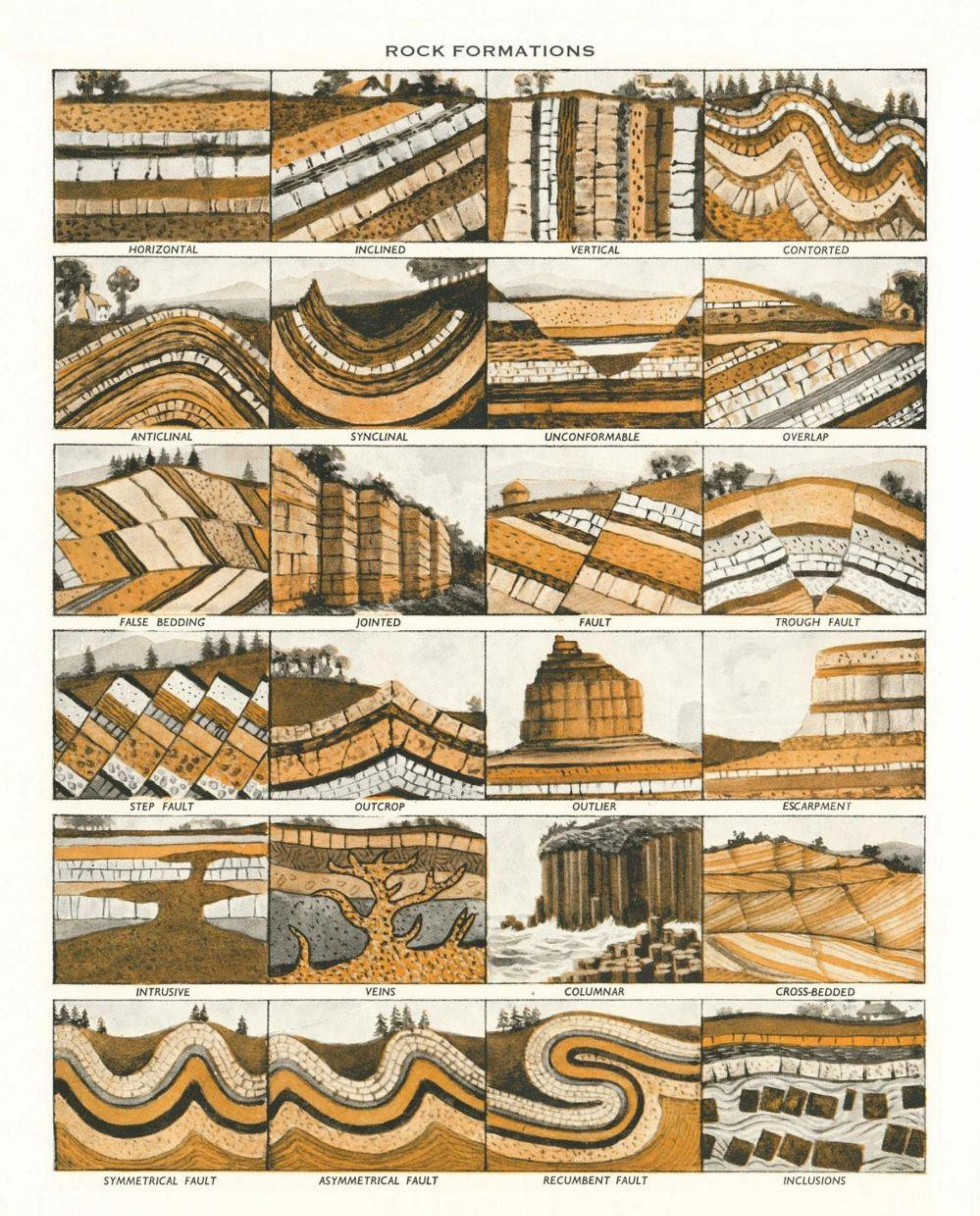
πηγή φωτό Paraskevi Nomikou

Εξάλλου, οι ερευνητές εντόπισαν πολλές υποθαλάσσιες κατολισθήσεις που πιθανώς συνδέονται με τον σεισμό του 1956 και οι οποίες θα μπορούσαν να έχουν ενισχύσει τα παλιρροϊκά κύματα. Αυτή την περίοδο είναι σε εξέλιξη η επεξεργασία και η ερμηνεία των δεδομένων, προκειμένου να σχηματιστεί καλύτερη εικόνα γι' αυτά τα γεγονότα του παρελθόντος και να υπάρξει καλύτερη κατανόηση του μέλλοντος σε μια από τις πιο ενεργές γεωδυναμικά περιοχές του ελληνικού υποθαλάσσιου χώρου.

Τα πρώτα ερευνητικά αποτελέσματα που προκύπτουν από την έρευνα, όπως αναφέρει η κ. Νομικού είναι ότι ο θαλάσσιος χώρος ανάμεσα στην Αμοργό και τη Σαντορίνη «είναι γεωδυναμικά ενεργός με πολλούς γεωκινδύνους. Έχουμε όμως, πλέον στη διάθεσή μας υψηλής ανάλυσης γεωφυσικά δεδομένα και τρισδιάστατα μοντέλα αναγλύφου, που θα μας βοηθήσουν να μελετήσουμε καλύτερα την παραμόρφωση του πυθμένα μετά τον σεισμό του 1956».

(Naftemporiki.gr με πληροφορίες από ΑΠΕ-ΜΠΕ, Κυριακή, 28 Μαΐου 2023, https://www.naftemporiki.gr/techscience/1476551/rompot-meleta-ton-ischyrotero-seismo-tis-mesogeioy-ta-teleytaia-200-chronia-poy-egine-metaxy-amorgoy-kai-anafis)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ



Νέα μυστικά στο φως για το ηφαίστειο της Σαντορίνης

Νέα στοιχεία για το μάγμα που εκτινάχθηκε από τη μινωική έκρηξη του ηφαιστείου της Σαντορίνης πριν από 3.600 χρόνια

Από την έκρηξη του 1939. Οι επιστήμονες δεν ανησυχούν για τη δραστηριότητα του ηφαιστείου της Σαντορίνης, καθώς συμβάντα με την ένταση της μινωικής μεγάλης έκρηξης μπορούν να επαναληφθούν κάθε 20.000-30.000 χρόνια. ΨΗΦΙΑΚΟ ΑΡΧΕΙΟ ΘΗΡΑΣ/ Λ. ΖΩΡΖΟΣ.

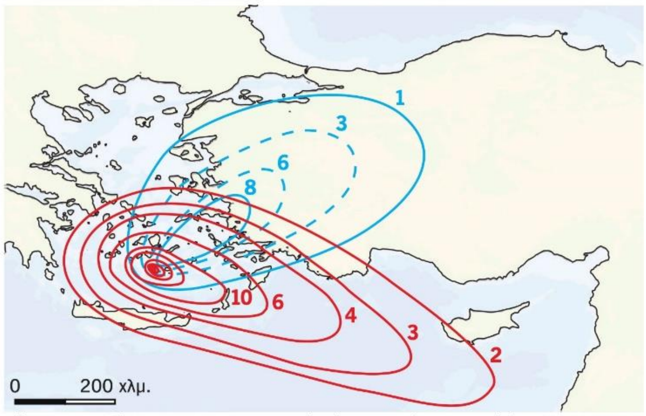
Είναι ένα από τα πιο μελετημένα ηφαίστεια στον κόσμο, κι όμως ακόμα δεν παύει να μας εκπλήσσει με νέα δεδομένα που φέρνει στην επιφάνεια η επιστημονική έρευνα. Ο λόγος για το **ηφαίστειο της Σαντορίνης** και την έρευνα των «μυστικών» του από μια διεθνή ερευνητική ομάδα με τον ίδιο λίγο πολύ πυρήνα τα τελευταία 10-15 χρόνια. Μια ομάδα η οποία όσο χρησιμοποιεί ανώτερα τεχνολογικά μέσα και μεθοδολογία προχωράει ακόμα πιο βαθιά σε συγκεκριμένη ανάλυση, ακόμα κι όταν αυτό οδηγεί σε αναθεώρηση προηγούμενων εκτιμήσεών της. «Ετσι αναπτύσσεται η επιστήμη», **λέει στην «Κ»** η αναπληρώτρια καθηγήτρια στο Τμήμα Γεωλογίας και Γεωπεριβάλλοντος του ΕΚΠΑ, **Εύη Νομικού**, εκ των συντελεστών της επιστημονικής ομάδας.

Στο κέντρο της προσοχής βρέθηκε το μάγμα που εκτινάχθηκε από τη μινωική έκρηξη του ηφαιστείου της Σαντορίνης πριν από 3.600 χρόνια και η οποία θεωρείται η μεγαλύτερη ηφαιστειακή έκρηξη στην Ευρώπη τα τελευταία 10.000 χρόνια. Το επιστέγασμα του έργου αρκετών ετών οδήγησε σε μια δημοσίευση στα τέλη Απριλίου 2023 στο **περιοδικό Nature Communications**, με επικεφαλής τον θαλάσσιο γεωεπιστήμονα Γενς Κάρστενς του γερμανικού Κέντρου Ωκεάνιων Ερευνών GEOMAR Helmholtz στο Κίελο και με τη συμμετοχή της κ. Νομικού και ερευνητών από τη Νορβηγία, τις ΗΠΑ και τη Γαλλία. Συνδυάζοντας τις πιο σύγχρονες γεωφυσικές και γεωλογικές μεθόδους, οι επιστήμονες επανεξέτασαν τη μινωική έκρηξη της Σαντορίνης και προσδιόρισαν ακριβέστερα τον όγκο του εκτοξευόμενου μάγματος, συμβάλλοντας στην κατανόηση των **μεγάλων ηφαιστειακών εκρήξεων παγκοσμίως**. Ας σημειωθεί πως παρά τη διεθνή σημασία τους για το επιστημονικό έργο και την κοινωνία, η εκτίμηση του όγκου των προϊόντων ηφαιστειακών εκρήξεων μεγάλης κλίμακας παραμένει περιορισμένη.

Από το 2002

Οι ερευνητές σε αυτή τη νέα δημοσίευση διαπίστωσαν ότι ο όγκος του υλικού που εκτινάχθηκε στο χερσαίο έδαφος και στον υποθαλάσσιο χώρο της Σαντορίνης ήταν 26-41 κυβικά χιλιόμετρα, σημαντικά μικρότερος από ό,τι είχε υποτεθεί προγενέστερα, όταν οι εκτιμήσεις έκαναν λόγο για 86 κυβικά χιλιόμετρα εκτοξευόμενου μάγματος. «Η μελέτη μας είναι αποτέλεσμα πολλών ωκεανογραφικών αποστολών από το 2002 και μετά και της συσχέτισης των ευρημάτων τους. Κατά τη διάρκεια της ερευνητικής αποστολής με το σκάφος «Poseidon» το 2017 συλλέχθηκε υλικό από τον πυθμένα του θαλάσσιου χώρου γύρω από τη Σαντορίνη, σε βάθος 6-12 μέτρων, το οποίο αναλύθηκε. Εντοπίστηκαν αποθέσεις τέφρας από τη μινωική έκρηξη σε 41 πυρήνες ιζημάτων και έτσι αποκτήσαμε νέα στοιχεία για τον υπολογισμό της ποσότητας του ηφαιστειακού υλικού. Σχεδιάσαμε εκ νέου την εξάπλωση της τέφρας μετά την έκρηξη, με βάση τα νέα στοιχεία, και είδαμε πως κινήθηκε κυρίως νοτιοανατολικά φτάνοντας μέχρι κάτω από την Κύπρο και σε δεύτερη φάση ανατολικά μέχρι τα βάθη της σημερινής Τουρκίας», εξηγεί στην «Κ» η κ. Νομικού.

Η εξάπλωση της τέφρας



Χάρτης της εξάπλωσης της ηφαιστειακής τέφρας από τη μινωική έκρηξη του ηφαιστείου της Σαντορίνης, περίπου τον 16ο αιώνα π.Χ. Με **κόκκινο** χρώμα η εξάπλωση του υλικού της πρώτης φάσης, με **γαλάζιο** της δεύτερης φάσης της έκρηξης. Οι αριθμοί υποδηλώνουν την πυκνότητα της μεταφερόμενης τέφρας.
Η ΚΑΘΗΜΕΡΙΝΗ

«Το 2019 μια νέα πολύ μεγάλη διεθνής ωκεανογραφική αποστολή, με τη συμμετοχή και πάλι Ελλήνων επιστημόνων, εξέτασε τα σεισμικά προφίλ, τα θαλάσσια γεωφυσικά προφίλ, με ηχοβολιστικά όργανα, τα οποία μπορούσαν να καταγράψουν τα διάφορα γεωλογικά πετρώματα σε βάθη 1-1,5 χιλιομέτρου. Συσχετίσαμε δεδομένα σεισμικής ανάκλασης και τομογραφίας κυμάτων P, που αποκτήθηκαν σε άλλη ωκεανογραφική αποστολή το 2015, με τις ιζηματολογικές αναλύσεις για να εκτιμήσουμε με μεγαλύτερη ακρίβεια τον όγκο της περίφημης μινωικής έκρηξης», συμπληρώνει η καθηγήτρια του ΕΚΠΑ. Οι ερευνητές έπρεπε να συνυπολογίσουν και την ποσότητα τέφρας που έπεσε στη στεριά, αλλά και τις ποσότητες ελαφρόπετρας, που έπεσε στο νερό και καθώς επιπλέει, απομακρύνθηκε από την περιοχή. Οπως σημειώνουν οι ερευνητές και στη δημοσίευσή τους, είναι η πρώτη φορά που υπολογίζονται τόσο ακριβείς τιμές για όλες τις επιμέρους συνιστώσες, καθώς μέχρι σήμερα οι εκτιμήσεις του όγκου της έκρηξης βασίζονταν είτε στην εκτίμηση του όγκου της κατάρρευσης της καλντέρας είτε στην ελλιπή καταγραφή των προϊόντων της έκρηξης. Και οι δύο προσεγγίσεις έδιναν περιορισμένα αποτελέσματα.

Από τον βυθό

«Ενα σπουδαίο στοιχείο στο συγκεκριμένο ερευνητικό έργο είναι πως εξετάσαμε τα ιζήματα στον βυθό της θάλασσας, όπου το ηφαιστειακό υλικό κατακάθεται αδιατάραχτο. Είναι σημαντικό πως από δω και πέρα, σημαντικά δεδομένα για τις ηφαιστειακές εκρήξεις θα έρχονται από τον βυθό, από τα θαλάσσια δεδομένα», συμπληρώνει η κ. Νομικού. Τα ευρήματα και η μέθοδος για τη συσχέτιση και τον υπολογισμό των τελικών ποσοτήτων είναι πολύ ενδιαφέροντα γιατί δίνουν νέο υλικό για να κατανοηθεί βαθύτερα ο τρόπος λειτουργίας των ηφαιστείων και να γίνει πιο σωστός ο υπολογισμός της ηφαιστειακής διακινδύνευσης. Οπως σημειώνει η κ. Νομικού, είναι αξιοσημείωτο το γεγονός πως παρότι το υλικό που εκτοξεύτηκε στη μινωική έκρηξη της Σαντορίνης ήταν σημαντικά μικρότερο απ' ό,τι υπολογιζόταν, η καταστροφή που προκλήθηκε ήταν πολύ μεγάλη.

Οι ηφαιστειακές εκρήξεις κατατάσσονται με βάση τον δείκτη ηφαιστειακής εκρηκτικότητας (VEI), ο οποίος εξαρτάται από την ποσότητα του ηφαιστειακού υλικού, το ύψος εκτίναξης της τέφρας και της στήλης που διαμορφώνεται, το πιθανό τσουνάμι, την εκρηκτική δύναμη. Η μινωική έκρηξη της Σαντορίνης είχε καταταγεί στο 5 προς 6 της κλίμακας (που αναπτύσσεται από 0-8), όταν στο 6 είναι οι μεγάλες εκρήξεις της Κρακατόα και στο Πινατούμπο.

«Δεν πρέπει να υπάρχει ανησυχία με το ηφαίστειο της Σαντορίνης. Σύμφωνα με τις αναλύσεις μας ανάλογα συμβάντα όπως αυτό που συνέβη πριν από 3.600 χρόνια μπορούν να επαναληφθούν κάθε 20.000-30.000 χρόνια. Στο μεσοδιάστημα υπήρξαν και άλλες εκρήξεις του ηφαιστείου της Σαντορίνης, τα ίχνη των οποίων βρίσκονται στα στρώματα που διαμορφώνουν την καλντέρα. Εκρήξεις όπως του 197 π.Χ. ή πιο πρόσφατα του 1950 δεν έχουν καμία σχέση όσον αφορά την ένταση της μινωικής Μεγάλης Εκρηξης. Εχουμε μάθει να ζούμε με το ηφαίστειο κι έτσι θα συνεχίσουμε», τονίζει η καθηγήτρια του Πανεπιστημίου Αθηνών.

«Αριστη συνεργασία»

«Η δημοσίευση αυτή είναι αποτέλεσμα της άριστης συνεργασίας μεταξύ των Ελλήνων και ξένων επιστημόνων που συμμετείχαν σε παλαιότερες ωκεανογραφικές αποστολές γύρω από τον υποθαλάσσιο χώρο της Σαντορίνης. Στον πυρήνα των ερευνητικών αποστολών υπάρχει μια ομάδα επιστημόνων, με πολλές κοινές εμπειρίες και άψογη συνεργασία. Και είναι σημαντικό πως σε αυτήν υπάρχουν Ελληνες επιστήμονες και πλαισιώνεται και με νέους ερευνητές και ερευνήτριες», αναφέρει η κ. Νομικού.

«Τα ηφαίστεια προειδοποιούν, δεν εκρήγνυνται ξαφνικά»

Η έρευνα στην ευρύτερη περιοχή της Σαντορίνης δεν σταματάει. Το δίμηνο Δεκεμβρίου 2022 – Ιανουαρίου 2023, στο πλαίσιο της μεγάλης ωκεανογραφικής αποστολής του διεθνούς προγράμματος εξερεύνησης των ωκεανών (IODP), πραγματοποιήθηκαν 12 υποθαλάσσιες ερευνητικές γεωτρήσεις πέριξ της Θήρας, σε βάθος ενός χιλιομέτρου. Οι υποθαλάσσιες γεωτρήσεις έγιναν στα σημεία που υπέδειξε η ερευνητική ομάδα ως κρίσιμα, έπειτα από την ανάλυση των σεισμικών προφίλ και της τοπογραφίας του υποθαλάσσιου πυθμένα, ώστε να επιβεβαιωθεί και με τις γεωτρήσεις ο όγκος του ηφαιστειακού υλικού της Μινωικής έκρηξης της Σαντορίνης. Σύμφωνα με τους συντελεστές της ερευνητικής ομάδας, επρόκειτο για ένα πολύ σπουδαίο έργο, με χρήση σύγχρονου πλωτού γεωτρύπανου και προηγμένων οργάνων, με κόστος αποστολής περίπου 25 εκατομμυρίων ευρώ, που ανέδειξε πολύ σημαντικά ερευνητικά δεδομένα. Η σχετική έκθεση προγραμματίζεται να δοθεί στη δημοσιότητα στα τέλη Ιουλίου και αναμένεται με μεγάλο ενδιαφέρον.

Υπό παρακολούθηση βρίσκεται και το ενεργό υποθαλάσσιο ηφαίστειο με το όνομα Κολούμπος, το οποίο βρίσκεται σε απόσταση 6,5 χιλιομέτρων βορειοανατολικά της Θήρας. Το ηφαίστειο Κολούμπος έγινε γνωστό ύστερα από μεγάλη ηφαιστειακή έκρηξη στις 27 Σεπτεμβρίου 1650, από την οποία προκλήθηκαν καταστροφές και θάνατοι από πρόκληση τσουνάμι, με μια ακτίνα επηρεασμού έως και 150 χλμ. «Υπάρχει το πρόγραμμα Santory για τον διαρκή έλεγχο της κατάστασης στο Κολούμπος. Εχουν τοποθετηθεί αισθητήρες, λαμβάνονται γεωχημικά στοιχεία, υπάρχουν κάμερες. Εχουμε καλή εικόνα της κατάστασης», σημειώνει η κ. Νομικού.

Η αναπληρώτρια καθηγήτρια στο Τμήμα Γεωλογίας και Γεωπεριβάλλοντος του Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών Εύη Νομικού (κάτω αριστερά) και η επιστημονική ομάδα σε ερευνητικό σκάφος.

Οπως εξηγεί η καθηγήτρια Γεωλογίας και Γεωπεριβάλλοντος στο ΕΚΠΑ, «τα ηφαίστεια προειδοποιούν. Δεν εκρήγνυνται ξαφνικά. Κατ’ αρχάς, μήνες πριν εκδηλώνονται σεισμικές δονήσεις στην περιοχή, καθώς το μάγμα στην ανοδική του κίνηση σπρώχνει τα πετρώματα και προκαλεί ανακατατάξεις. Η διαδικασία αυτή μπορεί να ξεκινήσει έως κι έναν χρόνο πριν από την έκρηξη ενός ηφαιστείου».

Οι επιστήμονες σήμερα εργάζονται συστηματικά για να συνδυάσουν την τεκτονική με την ηφαιστειακή διαδικασία. Η κατανόηση των μεγάλων γεγονότων του παρελθόντος, όπως της Μινωικής έκρηξης του ηφαιστείου της Σαντορίνης είναι πολύτιμη παρακαταθήκη για τη διευκρίνιση των διαδικασιών που ενεργοποιούνται και εξελίσσονται. Πολλές φορές πρέπει να πας πολύ βαθιά πίσω στον χρόνο για να προετοιμαστείς για πιθανά συμβάντα του μακρινού μέλλοντος.

Το πλούσιο ερευνητικό έργο που εξελίσσεται στη Σαντορίνη όλα αυτά τα χρόνια φωτίζει κι άλλες πλευρές. Για παράδειγμα, μέσα στα δείγματα από το ίζημα του βυθού βρίσκονται «αποτυπώματα» από τις συνθήκες που επικρατούσαν πριν από χιλιάδες έτη, από οργανισμούς που ζούσαν τότε. Από τα ίχνη αυτά μπορούν να εξαχθούν συμπεράσματα για τις κλιματικές συνθήκες που επικρατούσαν σε προηγούμενους αιώνες ή χιλιετηρίδες και να γίνουν συσχετίσεις με την υπό εξέλιξη διαδικασία της κλιματικής αλλαγής στην εποχή μας.

(Γιάννης Ελαφρός /Η ΚΑΘΗΜΕΡΙΝΗ, 12.05.2023, https://www.kathimerini.gr/society/562411309/nea-mystika-sto-fos-gia-to-ifaisteio-tis-santorinis)

Revised Minoan eruption volume as benchmark for large volcanic eruptions

Jens Karstens, Jonas Preine, Gareth J. Crutchley, Steffen Kutterolf, Willem G. M. van der Bilt, Emilie E. E. Hooft, Timothy H. Druitt, Florian Schmid, Jan Magne Cederstrøm, Christian Hübscher, Paraskevi Nomikou, Steven Carey, Michel Kühn, Judith Elger & Christian Berndt

Abstract

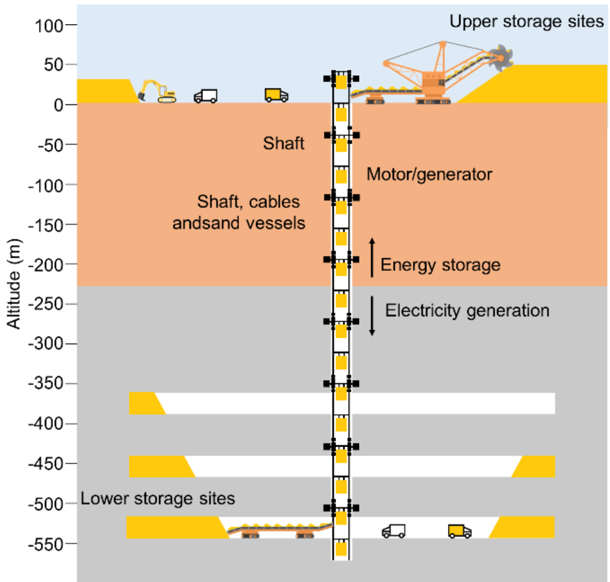
Despite their global societal importance, the volumes of large-scale volcanic eruptions remain poorly constrained. Here, we integrate seismic reflection and P-wave tomography datasets with computed tomography-derived sedimentological analyses to estimate the volume of the iconic Minoan eruption. Our results reveal a total dense-rock equivalent eruption volume of 34.5 ± 6.8 km³, which encompasses 21.4 ± 3.6 km³ of tephra fall deposits, 6.9 ± 2 km³ of ignimbrites, and 6.1 ± 1.2 km³ of intra-caldera deposits. 2.8 ± 1.5 km³ of the total material consists of lithics. These volume estimates are in agreement with an independent caldera collapse reconstruction (33.1 ± 1.2 km³). Our results show that the Plinian phase contributed most to the distal tephra fall, and that the pyroclastic flow volume is signifycantly smaller than previously assumed. This benchmark reconstruction demonstrates that complementary geophysical and sedimentological datasets are required for reliable eruption volume estimates, which are necessary for regional and global volcanic hazard assessments.

Karstens, J., Preine, J., Crutchley, G.J. *et al.* Revised Minoan eruption volume as benchmark for large volcanic eruptions. *Nat Commun* **14**, 2497 (2023). https://doi.org/10.1038/s41467-023-38176-3

Nature Communications **volume 14**, Article number: 2497 (2023) Cite this article

https://www.nature.com/articles/s41467-023-38176-3

How abandoned mines can be reused as gravity batteries



Underground Gravity Energy Storage system (credits Hunt et al.)

A new study proposes that abandoned mines can be reused as gravity batteries and store excess energy from renewable sources.

The study was led by the International Institute for Applied System Analysis (IIASA) and published in the "Energies" journal.

Furthermore, solar and wind power plants experience days where they produce more energy than the grid can use and the proposed solution for this comes through a technology called Underground Gravity Energy Storage (UGES).

UGES works by effectively raising sand containers, when excess energy is produced and thus price is low, and releasing those containers when extra energy is needed. This can be achieved through regenerative braking, which recovers braking energy from a slowing mass, and converts its kinetic energy into a form that can be immediately used or stored.

For this to be achieved, at least 300-meter-deep shafts are needed for the sand containers to fall effectively. Hence, abandoned mines are ideal for this use, as many of them already contain such shafts and are already connected to the power grid.

Also, according to Julian Hunt, lead author of the study and researcher with (IIASA), this technique could remediate the effects of a closing mine to the local community, as some jobs will still remain available in the new power storing facility.

Finally, it is noted that investing costs in UGES vary between 1-10 USD/KWh, while power capacity ones at 2 USD/KW and an estimated 7-70 TWh potential capacity exists worldwide.

Sources: www.independent.co.uk, www.euronews.com, www.mining.com, iiasa.ac.at, www.mdpi.com

(Geoengineer.org, Jan, 11, 2023, https://www.geoengineer.org/news/how-abandoned-mines-can-be-reused-as-gravity-batteries)

Underground Gravity Energy Storage: A Solution for Long-Term Energy Storage

Julian David Hunt, Behnam Zakeri, Jakub Jurasz, Wenxuan Tong, Paweł B. Dąbek, Roberto Brandão, Epari Ritesh Patro, Bojan Đurin, Walter Leal Filho, Yoshihide Wada, Bas van Ruijven and Keywan Riahi

Abstract

Low-carbon energy transitions taking place worldwide are primarily driven by the integration of renewable energy sources such as wind and solar power. These variable renewable energy (VRE) sources require energy storage options to match energy demand reliably at different time scales. This article suggests using a gravitational-based energy storage method by making use of decommissioned underground mines as storage reservoirs, using a vertical shaft and electric motor/generators for lifting and dumping large volumes of sand. The proposed technology, called Underground Gravity Energy Storage (UGES), can discharge electricity by lowering large volumes of sand into an underground mine through the mine shaft. When there is excess electrical energy in the grid, UGES can store electricity by elevating sand from the mine and depositing it in upper storage sites on top of the mine. Unlike battery energy storage, the energy storage medium of UGES is sand, which means the self-discharge rate of the system is zero, enabling ultra-long energy storage times. Furthermore, the use of sand as storage media alleviates any risk for contaminating underground water resources as opposed to an underground pumped hydro storage alternative. UGES offers weekly to pluriannual energy storage cycles with energy storage investment costs of about 1 to 10 USD/kWh. The technology is estimated to have a global energy storage potential of 7 to 70 TWh and can support sustainable development, mainly by providing seasonal energy storage services.

Energies **2023**, *16*(2), 825; https://doi.org/10.3390/en16020825

https://www.mdpi.com/1996-1073/16/2/825

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ

Direct Steerable Pipe Thrusting

Task Committee on Direct Steerable Pipe Thrusting

Sponsored by the Task Committee on Direct Steerable Pipe Thrusting of the Committee on Trenchless Installation of Pipelines of the Utility Engineering & Surveying Institute of ASCE

Direct Steerable Pipe Thrusting details how engineers and construction professionals can utilize the Direct Steerable Pipe Thrusting (DSPT) method, also known as Direct Pipe, a relatively recent innovation in the trenchless pipeline installation industry, which combines characteristics of horizontal directional drilling (HDD) and conventional microtunneling to design and install pipelines in ground conditions that would be challenging for other trenchless methods.

Topics include

- History of DSPT;
- Overview of the DSPT method;
- Parameters that should be considered when determining the applicability and constructability of a potential DSPT project;
- Guidance on how to conduct site investigations that are critical to the DSPT process;
- Design process involved in the DSPT installation method, pulling techniques from both HDD and microtunneling;
- Installation stresses, evaluation, considerations, and calculations;
- Contract documents and forms, delivery methods, and potential legal issues associated with DSPT projects; and
- Overview of the construction phase of DSPT installations.

MOP 155 provides information on the DSPT method and serves as a contribution to the DSPT engineering practice to benefit engineers, owners, contractors, equipment manufacturers, and other project and industry stakeholders.

(ASCE, 2023)

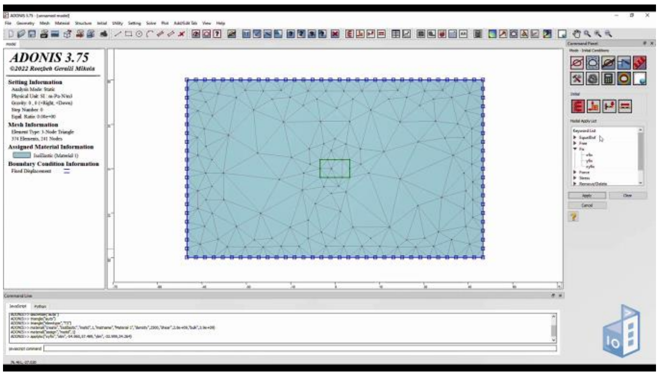
ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

GEO-TRENDS REVIEW

www.mygeoworld.com/geotrends/issues/23-May-2023

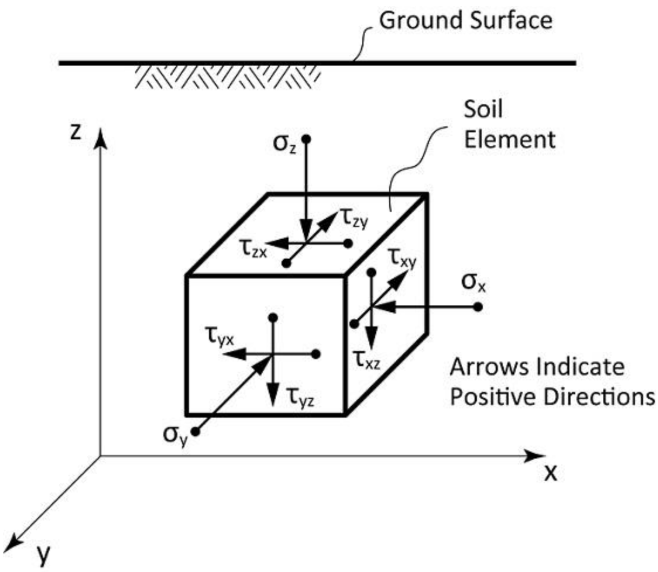
Κυκλοφόρησε το Τεύχος 23, Μάϊου 2023 με τα ακόλουθα περιεχόμενα:

ADONIS: A Free Finite Element Software for Geo-Engineers 10 May 2023



Read More

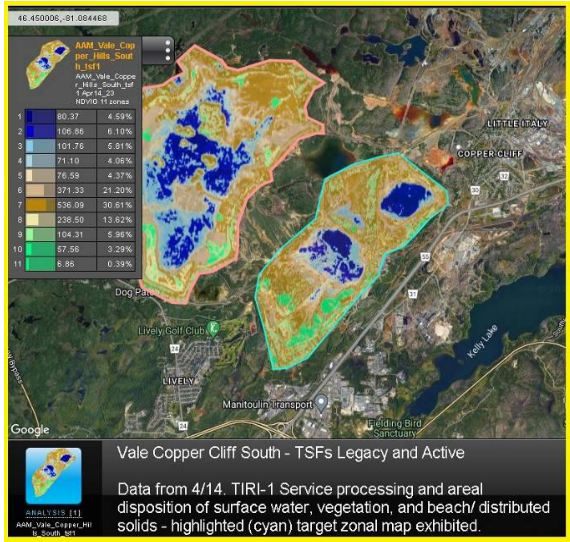
Online Lecture Notes on Soil Mechanics - Chapter 2 uploaded - 11 May 2023



Chapter 2 Stresses in Soils by the book Athanasopoulos, G. A. (2021) "Online Lecture Notes on Soil Mechanics" is one of the recent chapters uploaded. Three chapters of the book have so far been added to Geoengineer.org, all of which are available for free.

Read More

View of Vale Base Metals Sudbury Copper Cliffs South operational and Legacy TSF - 08 May 2023



Read More

Bulletin Vol. 17, Issue 2 - April 2023 published - 12 May 2023

Read More

International Geosynthetics conference GEOAFRICA 2023 - 11 Mar 2023

Read More

ISSMGE Interactive Technical Talk Episode 6: Unsaturated Soils (TC106) - 13 Apr 2023

The sixth episode of International Interactive Technical Talk has just been launched and is supported by TC106. Prof. Enrique Romero, Dr. Maha Saleh and Liuxin Chen are discussing with Dr. Marc Ball...

Read More

Two houses slide off cliff after landslide in Draper, Utah - 27 Apr 2023

Read More

ISSMGE Lifetime Achievement Medal - 12 May 2023

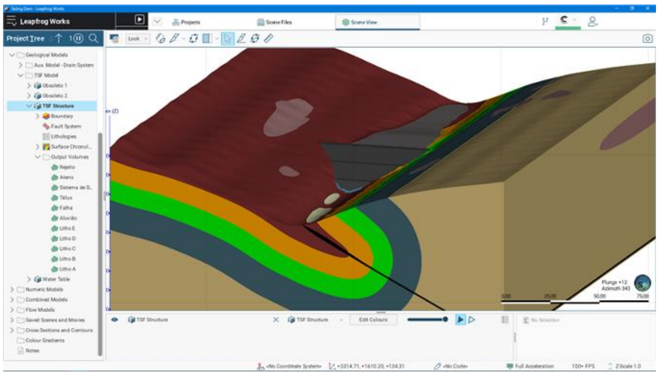
Read More

The Geo-community now has its own discord server! - 19 May 2023

We are pleased to announce the launch of the Geoengineer.org discord server, a service where Geotechnical Engineers from all over the world will be able to message or voice chat with each other ...

Read More

PLAXIS 2023.1 New release is out! - 03 Mar 2023



The latest releases of PLAXIS marks our definitive transition to becoming part of Seequent, The Bentley Subsurface Company, with some minor cosmetic changes and a change to the version numbe...

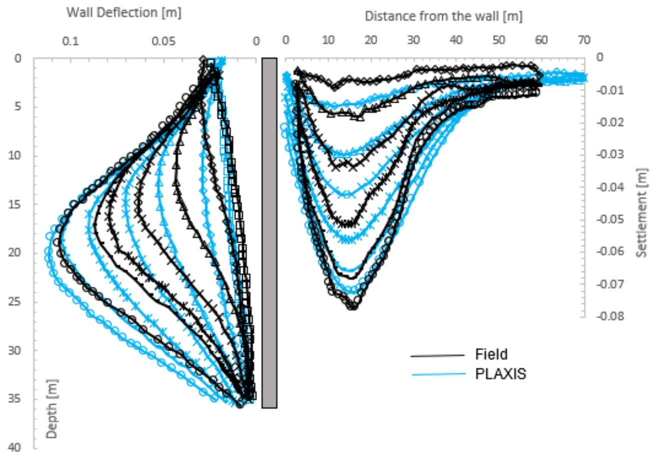
Read More

Seequent unveils SLOPE3D: Advanced stability analysis tool to help engineers design safer slopes - 05 Apr 2023

SLOPE3D extends capabilities of GeoStudios trusted 2D SLOPE/W product into 3D, significantly enhancing stability assessments for slopes in the mining and civil industries. CALGARY, CANADA, Ap...

Read More

Undrained analysis of a deep excavation in clayey soils using PLAXIS Hardening Soil model in RS2 - 04 May 2023



When analyzing a geotechnical problem, different design parameters are utilized depending on drained or undrained conditions. A drained analysis is typically used for soils with large permeabilities,...

Read More

Final design of HS2 Chiltern Tunnel's North Portal revealed - 25 Mar 2023

Read More

Call for Abstracts: 5th International Conference on Transportation Geotechnics - 14 Apr 2023

On behalf of the Organising Committee, we have the pleasure of inviting you to the 5th International Conference on Transportation Geotechnics (ICTG) 2024, to be held in&nbs...

Read More

Research Study About Women in Engineering Student Projects - 23 Mar 2023

Greetings, We are Stacey Kulesza and Mojdeh Pajouh. We are faculty in the College of Engineering at Texas State University and the University of Nebraska Lincoln. Together with our colleagues, Drs....

Read More

Call for Abstracts: 4th International Society for Intelligent Construction Conference (ISIC 2024) - 17 Mar 2023

The International Society for Intelligent Construction 2024 Conference (ISIC 2024) will be held in Orlando, Florida, USA, from 10 to 12 September 2024. Intelligent construc...

Read More

News and Information Circular - May 2023 - 12 May 2023

Read More

Community for African Geo-Professionals - 06 Apr 2023

Read More

Completely weathered soil collected from SPT sampler - 27 Mar 2023

Read More

Massive sinkhole in Daisetta, Texas, starts growing again, after 15 years of being stable - 06 Apr 2023

Read More

Iraqi Scientific Society for Soil Mechanics and Foundation Engineering - 21 Mar 2023

Read More

Lexicon now also in Greek! - 09 Mar 2023

Read More

Second building collapses after landslide in Tijuana, Mexico - 12 Apr 2023

Read More

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

IGS NEWSLETTER – May 2023

Helping the world understand the appropriate value and use of geosynthetics

www.geosyntheticssociety.org/newsletters

- IGS Launches 'Strategy 2022-2026' Report READ MORE
- 5th GeoAmericas 'A Major Platform For Pan-American Activities' READ MORE
- Sustainability Leads 5th GeoAfrica Conference READ MORE
- Register Now For Geomembranes Webinar READ MORE
- Praise For Speaker-Focused GeoAfrica4 Conference READ MORE
- Geotecnia Journal Wins Wider Audience READ MORE
- Remembering IGS Spain's Pedro Abad Santos READ MORE
- Call for Papers: Special Issue on 'Soil-Geosynthetic Interaction' READ MORE
- Young Members! Apply Now For Travel Grant To 12th ICG READ MORE
- Calendar of Events

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2019 – 2023)

ΕΕΕΕΓΜ

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

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

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

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