



Online WEBINARS 2023

March-July

IAG Tectonic Geomorphology Working Group



Under the auspices of the

Hellenic Committee for Geomorphology and Environment of the Geological Society of Greece

Agenda

Conveners: **Giandomenico Fubelli, Konstantinos Tsanakas, Andrew Howell**

March 2023

Dr. Emmanuel Vassilikis

Associate Professor, National and Kapodistrian University of Athens, Greece

Presentation of the evolution of the supra-detachment "Messara basin" (Crete, Greece) based on field work and tectonic geomorphology techniques



The role of recently identified NNE-SSW trending strike slip fault zones on the development of the E-W trending supra-detachment Messara basin in Central Crete is presented in this talk. The examination of several tectonic and morphotectonic criteria along with high and medium resolution remote sensing image interpretation are leading to the conclusion that this quite recently formed basin on the top of the hanging wall of the Southern Crete extensional detachment fault is still evolving and the lateral slip of faults trending oblique to the Hellenic trench are very significant. The history of this supra-detachment basin starts during Middle Miocene only after the compressional phase of the alpine units' nappe pile stacking has been accomplished at the southern part of the Hellenic Arc system. The eastern marginal fault zone is almost vertical with some fault surfaces dipping to the west and has a strong left lateral component which is active at least since Tortonian, as this has been proved by tectonic analysis of syn-sedimentary faults found on marine sediments, along the faulted area. A segment of this fault zone was reactivated during the recent earthquake of 27/9/2022. The westernmost segment of the detachment seems to have the highest slip rate as the largest structural omission related to the alpine units has been detected along its trace. The new independent supra-detachment basin is stabilizing whilst internal deformation takes place and becoming homogenous during the Holocene as the modern topography and river drainage show.

April 2023

Dr. Julius Jara-Muñoz

Associate Professor, University of applied Sciences Hochschule Biberach, Germany

Coastal geomorphic markers, advances and applications to elucidate tectonic mechanisms and rates



Understanding the processes that govern the coastal landscape evolution is one of the primary goals of coastal geomorphology and neotectonic investigations. Coastal realms are highly dynamic environments hosting more than 40% of the world's population (around 2 billion people), representing highly sensitive areas regarding earthquake hazards and the effects of global warming and sea-level rise. Recent advances on coastal tectonic geomorphology using novel techniques applied at different temporal and spatial scales have opened new paradigms regarding the mechanisms driving surface deformation and the interaction between coastal dynamics and earthquakes. In this presentation I will introduce the processes responsible for the formation and preservation of coastal geomorphic markers, followed by a review and discussion of recent studies and novel approaches on the field of tectonic coastal geomorphology.

May 2023

Dr. Cengiz Yildirim

Professor, Istanbul Technical University, Türkiye

Tectonic Geomorphology of Türkiye (Anatolia), where continents subduct, collide and escape



Türkiye, hereinafter Türkiye, is located between the Eurasian, African and Arabian plates. Their relative movements create one of the most actively deforming regions on Earth. This deformation creates Highlands up to 5000 m in the East, thousands of km long tectonic troughs, high mountain ranges in the North (Pontides) and South (Taurides) up to 3500 m, hundreds of km long horst and grabens in the West, an orogenic plateau in the central part with an average 900 m elevation (Central Anatolian Plateau). When we look at the regional tectonic configuration, the African plate moves to the north (6 ± 2 mm/yr). It subducts along the Hellenic and Cyprus arcs beneath the Aegean and Anatolian Microplates, respectively. The Arabian Plate also moves North but faster (18 ± 2 mm/yr) than the African Plate along the Dead Sea Transform and collides with the Anatolian Plate in Eastern Turkey along the Bitlis-Zagros Suture Zone. This collision creates the East Anatolian Highlands, characterised by strike-slip and reverse faults together with active volcanoes. The Anatolian Microplate escapes to the West between collision in the east and subduction in the West along the North and East Anatolian Fault zones. These fault zone rates are 25 ± 2 mm/yr and 10 ± 2 mm/yr, respectively. The cumulative offset of The North Anatolian Fault Zone is 85 km, but 15 km along the East Anatolian Fault Zone. The westward escape creates an anti-clockwise rotation of the Anatolian Plates toward the Hellenic Arc. The space-based velocity of the Aegean Plate as the up-riding block of the subduction reaches 30 ± 2 mm/yr because of lithospheric slab-breakoff along the Hellenic Arc. As a result of the roughly north-south oriented back-arc extension along the Hellenic arc, several east-west oriented horst-and-graben structures are formed in Western Anatolia. However, there are also low-strain regions on the Anatolian Plate. For instance, the Central Anatolian Plateau. This orogenic plateau is characterised by very slow normal faults that offset shorelines of internally drained paleolakes. This webinar will present information about mode, mechanism, timing and rate of deformation examples from different morphotectonic domains in Türkiye.

June 2023

Dr. Marta Della Seta Associate Professor & Dr. Michele Delchiara

Sapienza University of Rome, Italy

The role of tectonic uplift and landscape evolution in Mass Rock Creep deforming slopes: case studies from Zagros Mountains (Iran)



Gravity-induced slope deformations are usually related to the Mass Rock Creep (MRC) process that acts on a large time-space scale through a continuous and non-linear variation of the stress-strain conditions of entire portions of slopes. Such time-dependent process is viscosity-driven and is also strongly conditioned by tectonics and by the morphological evolution of valley-slope systems. Both uplift and the drainage network evolution can, indeed, kinetically release portions of slopes isolating a rock mass carapace that starts to deform with possible acceleration over time towards an ultimate collapse. However, the difficulty to demonstrate such a theoretical scheme is represented by the difficulty of estimating accurately the starting time of the process, of discriminating the ongoing stage of the MRC process, as well as of determining the rheology of the jointed rock mass. To fill this gap, it has been challenging to distinguish the contributions of tectonics and landscape evolution in the development of MRC-driven deformations through an experimental methodological approach tested in Lorestan (Zagros Mountains - Iran) along a transect oriented parallel to the direction of propagation of the fold morpho-structures. Here we present the morpho-evolutionary reconstructions for 3 case studies from the analysis and dating of geomorphic markers that allowed the identification of the MRC initiation time. Based on such time constraints, a Landscape Evolution Model was implemented for each case study. The computation of the LEM-based strain rate, and consequently of the displacement rate, was performed through a sensitivity analysis on the viscosity parameter, allowing to reconstruct the deformation history linked to the MRC process of the simulated slopes. It can be concluded that the landscape evolution modelling, chronologically constrained by the analysis of geomorphic markers, allows reconstructing the creep history of slope-valley systems involved in MRC. The presented method will be joined and compared in a multi-modelling approach with stress-strain numerical modelling with the aim to calibrate the rock mass rheology and to constraint in back analysis the evolution of large-scale viscosity-driven processes.

July 2023

Dr. Jonathan Griffin

Geoscience Australia, Australia

Late Quaternary Slip Rates for the Hyde and Dunstan Faults, Southern New Zealand: Implications for strain migration and the earthquake cycle



Reverse faulting in Otago, southern New Zealand, accommodates distributed tectonic convergence on the eastern side of the Australian-Pacific plate boundary. Paleoseismic records from some of the faults in the region show highly variable earthquake recurrence times, with long periods of quiescence separated by periods of earthquake activity. Here we develop a longer-term context for these records, using cosmogenic radionuclide dating of faulted alluvial fan surfaces to characterize the late Quaternary slip rates on two significant faults within the system, the Hyde and Dunstan faults. We determine an average slip rate of 0.24 mm/yr (0.19 - 0.29 mm/yr at 95% confidence) for the Hyde Fault since about 115 ka, and an average slip rate of 0.16 mm/yr (0.12 - 0.21 mm/yr) for the Dunstan Fault since about 320 ka. Both faults show increases in slip rate of a factor of three to five times the average long-term rate over timescales of 10 kyr. Increases in slip rate are out of phase on the two faults, supporting a hypothesis that strain is shared within the fault system over timescales on the order of 10 kyr. Over longer timescales, on the order of 100 kyr, slip rates can be well-approximated by a linear fit, providing an upper limit on the variability of fault slip rates with time. Approaches for combining the short-term paleoseismic record with the long-term slip rate record to improve earthquake forecasts are discussed.

For exact dates and updates check webpage at: <http://www.geomorph.org/tectonic-geomorphology-working-group/>

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