for triggering of the main rupture on the Greendale fault from rupture initiating on the Charing Cross fault. The Charing Cross fault is a small reverse fault that is compatible with both regional first-motion focal mechanisms as well as inversion of regional data for an initial moment tensor solution. The relative orientation of the regional stress field and the faulting regime may have also contributed to triggering rupture on a few other small faults on which the finite-fault inversions image minor slip. Owing to their complexity, recorded waveforms provide relatively poor constraints on whether coseismic slip and dynamic triggering occurred on some of the faults with much less slip. Current work focuses on evaluating how well the UCERF3 (USGS Open File Report 2013–1165) criteria for forecasting multi-segment ruptures in California apply to this complex rupture in New Zealand.

Paleoseismic Investigations of the Kango fault, South Africa: Incorporating Temporal and Spatial Clustering Behavior into a Seismic Source Characterization Model

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The Kango fault (a Mesozoic basin-bounding fault) lies in a seismically quiescent region within the Eastern Cape Province of South Africa, but has evidence for three latest Pleistocene to Holocene surface-faulting events preceded by a long period of several tens of thousands of years of no activity—behavior typical of other stable continental region (SCR) faults. The 92–101 km long eastern segment of the Kango fault appears to be unique among the faults within the Ceres-Kango-Baviaanskloof-Coega fault system in that it shows evidence of repeated normal-slip surface-rupturing events in the Quaternary. The occurrence of these events—two events in the past 10–15 kyr along the western part of the approximately 100 km–long reactivated portion of the fault, and at least one event between 22.6 ka and 25.4 ka along the eastern part of the reactivated part of the fault—indicates that the Kango fault may be within a period of higher activity. Low cumulative Quaternary displacements (10–33 m) and low long-term average slip rates are based on measured offsets of high pediment surfaces and a buried erosional strath surfaces that record long-term (350 kyr to 3 Myr) deformation rates on the reactivated part of the Kango fault. Paleoseismic trenching, geochronology investigations using both cosmogenic nuclide (10Be/26Al) and OSL dating methods, geomorphic mapping and analysis, drilling, and geophysical studies provide information on the size and timing of Quaternary faulting events. The results of these studies were incorporated into a seismic source model that accounts for temporal and spatial clustering in the assessment of the recurrence behaviour of the reactivated Kango fault and adjacent faults within the Ceres-Kango-Baviaanskloof-Coega fault system.

Comprehensive Study on Holocene Paleoearthquakes in Daqingshan Piedmont Fault, Inner Mongolia of China

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Daqingshan piedmont fault is a normal dip-slip fault. It spreads along south piedmont of Daqingshan in Inner Mongolia of China. This fault happened many frequent great paleoearthquakes in Holocene. Paleoseismic events of this fault since Holocene were revealed through digging and trench techniques. This paper studies Holocene paleosols on the paleo-alluvial-pluvial fans of hanging wall and gullies geomorphology of footwall which record the fault activity history.

On the hanging wall we study alluvial fans' sections containing the ancient soil layers at intervals. The results show that Daqingshan piedmont alluvial fans in Holocene develop 3 periods ancient soil layers. We assume that in the same period of soil development, the development of paleosol formation was interrupted and formed in similar time multiple interbeds of paleosol and gravel layers, which are caused by the fault activities. That is, the gravel layer between two adjacent paleosol layers represents an ancient earthquake event. Thus we can date paleosol layers which are up and down the gravel layer to define paleoseismic events.

On the footwall we extract gullies from high resolution IRS-P5 DEM data. 25 gullies across the fault on the footwall have been extracted from DEM. Knickpoints caused by fault activities in Holocene have been extracted from profiles of gullies for further step. Combining with the retreat distances and the retreat rates of knickpoints on the gullies, we get forming time of each rank knickpoints on the the fault. Thus, paleo-earthquake series in Holocene of the fault have been obtained.

We get Holocene paleoearthquakes records from both walls of the faults. Then we contrastively analyse the results with trenches results together. The result demonstrates that paleosols ages on the Paleo-alluvial-pluvial fans and knick points sequence on the footwall have very close correspondence relations with paleoseismic events along the Daqingshan piedmont fault.

Faulting Constraints and Incision Rates in the Krsko Basin and Upper Sava River, Eastern Slovenia

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Quaternary Incision rates have been constrained for the upper Sava River (roughly 100 km from the Alps) using cosmogenic radionuclide (CRN) burial 26Al/10Be dating, as well as quartz and feldspar optically stimulated luminescence (OSL). These new data have helped to constrain the ages of not only incision rates, but also tectonic features and processes in southeastern Slovenia, an area located within the transition zone between the Sava Folds and the southeastern extension of the Mid-Hungarian Zone and an area of low to moderate tectonic activity. Within the region, the geomorphic expressions of Quaternary tectonics and mass wasting processes are subtle due to heavy vegetation, anthropogenic activity, and reasonably high rates of erosion. Nevertheless, new topographic data from light detection and ranging (LiDAR) DEMs have allowed us to recognize and differentiate complex surface process – the coupling between tectonic and mass wasting processes that were previously identified as purely tectonic landforms.

The new CRN and OSL-derived geochronology has confirmed prior age estimates that were based on stratigraphic positions and limited geochronology. This confirmation is not surprising, although it is critical because recent conjecture has implied the region is far more tectonically active than previously believed. The geochronology from this study suggests that the region has been undergoing lower tectonic deformation rates than originally postulated. The LiDAR data have also shed light on the mass-wasting surface processes that have influenced the tectonic interpretation of the landscape. These data contribute to providing constraints on the ages of the Quaternary stratigraphy, ultimately providing constraints on regional deformation patterns. This has important implications for seismic hazard analyses for critical facilities and provides important insights as to the process-dominance between regional tectonics and climate as major agents of landscape change.

Seismic Location and Processing Techniques

Poster Session · Friday · 2 May · Cook/Arteaga

A Linear Formulation for Earthquake Location in a Homogeneous Half-Space Based on the Bancroft Algorithm Developed for GPS Location

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The traditional approach to both earthquake and GPS location problems in a homogeneous half-space result in a seemingly nonlinear relationship between a set of known positions, seismic stations or GPS satellites, and an unknown point, an earthquake hypocenter or GPS receiver. Linearization, followed by an iterative inversion, is typically used to solve both problems. Although sources and receivers are inverted in the earthquake and GPS location problems, the observation equation is the same for both due to the principle of reciprocity. Consequently, single step linear solutions for the GPS location problem, such as the Bancroft algorithm, can also be used to solve for earthquake hypocenters. We apply the Bancroft algorithm to synthetic data for the New Madrid seismic network, showing improvements in both precision and accuracy compared to traditional methods. We also show how tools commonly used by the GPS community can be used to better estimate the precision of locations obtained by a seismic network.

Low-Frequency-Earthquake Locations Determined using Time-Reverse-Imaging

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