and that considerable crustal mass is exported from the region fluvially. Thus, it is likely that the Three Rivers serve as significant spatially extensive sinks of mass at the Earth’s surface. This inference has not been taken into consideration in geodynamic models to date. Under these conditions, eastward-moving thick crust of Tibet to the side of the indicator does not have to propagate indefinitely to the east, it could well be offset by surface mass removal in the Three Rivers region. A simple mass-balance calculation suggests that a modest erosion rate of only 0.2 mm/yr could account for a significant proportion of the eastern crustal erosion. Therefore, there will be an overall decrease in crustal thickness and subsequently allow the eastern crustal admittance out of Tibet be consumed by erosion.

T41E-04 0930h
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The Nanga Parbat-Haramosh Massif (NP) is located in the northwest Himalayas of Pakistan and is a map-exposure of Indian crust surrounded on three sides by the inland arc rocks of the Ladakh and Kohistan terranes. Located in the northeastern Himalayan syntaxis, the NP is thought to be a composite tectonic and metamorphic history involving an earlier Himalayan metamorphic event associated with crustal thickening followed by fast exhumation and rapid erosion. Here we show that the present-day crustal mass balance and fluid flow are consistent with the highest topography which we believe is not erosional. Metamorphic mineral assemblages reveal steep northward metamorphic gradients away from the granite-grade cordierite-sillimanite-bearing massif core into upper-greenstone and amphibolite facies rocks to the south and eastward toward the Late Cretaceous Pan-African domain. These processes are consistent with crustal shortening during orogenesis. Nanga Parbat, an 8 km high peak etched from Indian crust, is characterized by extremely rapid exhumation (1400 m/kyr), the presence of hot springs, young intrusive rocks (<1 Ma), and, in some areas, magnetized rocks ( <1 Ma). As part of a multidisciplinary study we deployed a 60 station, three-component short-period broadband seismic array perpendicular to the 1Q (20 km long) to assess the crustal thickness and determine shear wave velocity. In a four month window (May-September 1996) we recorded over 1500 associated events. Joint inversion for velocity and hypocentral locations yields Vs=5.6-6.5 km/s and Vp=3.3 to 3.5 km/s within the main mass. We interpret the rapid exhumation and high pressures along a boundary associated the transition from brittle to ductile deformation. This observation is consistent with petrologic and thermochronologic data indicating the location of a high-temperature crustal root beneath Nanga Parbat. While we see many classic impulsive arrivals, others appear more harmonic, not unlike seismic signals from detachment zones. Here, the mid-crustal zone is interpreted to reflect under pressure at shallow depths. These events are intriguing given the evidence for recent igneous activity focused at the core of the massif and results from fluid inclusion indicating a dry, smectic phase associated with the hydrothermal system below 3 km depth. We recorded both the seismic phases associated with the brittle behavior at depth. The Tseko intrusions define a well-constrained fault plane, a possible pathway for fluid migration. This page may be freely copied.
T41D-06 0830h POSTER

Complexities in the Seafood Spreading of the Lesser Lawn Smelt
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We present a ~200m resolution compilation of nearshore herring and sand lance (Ammodytes hexapterus) and salmon (Oncorhynchus spp.) abundance distributions using standard GIS tools and image processing techniques. We compare the distribution of salmon and herring with those of sand lance to assess the importance of these forage species. The data show a general pattern of high abundance of salmon and herring in areas with high sand lance abundance. This suggests that sand lance may be an important food source for salmon and herring in the region.

T41D-07 0830h POSTER

Asymmetric sea-floor spreading in the central Mariana Trench
Nobukazu Sano*1,2 (1-408-616-2500; snsano@arch.chihoku.ac.jp) and Toshitugu Yasuhara1,2 (1-262-356-3013; yasu@arch.chihoku.ac.jp)
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We present evidence for asymmetric sea-floor spreading in the central Mariana Trench (MT) at 11°N. We used seismic reflection data, bathymetry, and magnetic anomaly data to test the hypothesis that the MT is spreading asymmetrically. Our results support this hypothesis and suggest that the MT is spreading asymmetrically.

T41D-09 0830h POSTER

The Late Paleozoic Evolution of the Paraná Basin: An Example of Subduction-Induced Subsalinity
Marcus C. G. de Oliveira1,2,3 (1-946-390-321; marcos@geology.ufmg.br) and Russell N. Pyle1,2,3 (1-946-390-321; rnp@geology.ufmg.br)
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We present a model of the late Paleozoic evolution of the Paraná Basin, which is located in southern Brazil. Our model suggests that the basin was formed by subduction-induced subsalinity, which is a result of the westward movement of the South American plate.

T41E-01 0830h INVITED

Fire and Ice - The Geomorphology of Metamorphism: Mesoscale Linking Between Surficial and Crustal Processes I (joint with H. V)
Presiding: P. Zeitzer, Lehigh University; C P Chamberlain, Dartmouth College

T41E-03 0815h INVITED

Dual Interest in the Three Rivers of Eastern Tibet: As Markers of Strain, and as Exporters of Crustal Mass from the Region
Benedikt Hall1 (206-544-1196; hall1@uw.edu) and Peter Mohr2 (peter.mohr@u.ofa.mt.edu)
1Director, Quaternary Research Center, University of Washington Bothell Campus, Bothell, WA, USA and 2Department of Geography, University of Michigan, Ann Arbor, Michigan, USA
We present evidence for the presence of dual interest in the Three Rivers of Eastern Tibet, which are considered to be markers of strain and as exporters of crustal mass from the region. Our results suggest that the Three Rivers have played a significant role in the tectonic processes that have shaped the region.

T41E-04 0815h INVITED

Big Mountains, Big Rivers and Hot Rocks: Beyond Isotropy
Peter O. Koons (414 3797519; pkoons@uwm.edu) and 3797519; pkoons@uwm.edu)
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Pre-intrusive topography generally influences deformation in convergent settings by controlling crustal shortening and promoting topographic collapse. This study focuses on large-scale topographic features in New Zealand and the Hawaiian Islands, which show evidence of crustal shortening and topographic collapse. The results suggest that large-scale topographic features can influence the pattern of crustal deformation, and that the interaction between topography and crustal processes may control the distribution of crustal deformation.

T41E-05 0815h INVITED

Extensive lithospheric deformation on the eastern margin of the Indian Ocean/Marsson collision has brought three major rivers in exceptionally steep topography. As river channels, surface water in the western part of the Kosi River and Yangtze Rivers are only a few kilometers apart, about 100 times closer than the mean distance of the rivers. The high gradients and channel topography of the rivers are also associated with the order of 1000 km of northwested motion of India relative to southern China. This suggests that the region of the Three Rivers has been undergoing rapid tectonic and geological processes, resulting in the formation of steep topography and major river systems.
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