fashion southwest of the Haiyuan fault. The crustal velocities have significant variations along the profile. The average crustal P-wave velocities are 6.3 km/s in the Ordos block, 6.22 km/s in the Haiyuan arcuate tectonic region, 6.25 km/s in the Qilian block, 6.2 km/s in the Qinling block, and 6.1 km/s in the Songpan-Ganzi terrane. The average crustal velocity is 6.22 km/s along the profile, which is 0.23 km/s lower than the global average (6.45 km/s). Combined P-wave velocity and Poisson's ratio suggest that the crust is dominantly felsic in composition with an intermediate-to-mafic composition in the lower crust. However, a mafic lower crust is absent in the NE margin of the Tibetan Plateau from the Songpan-Ganzi terrane to the Ordos block. Felsic lithologies are inferred to be in greenschist-to-amphibolite metamorphic facies. There are mid-crustal low velocity zones in the Qinling block and the Haiyuan arcuate tectonic region. The low velocity zones have low S-wave velocities and high Poisson's ratios, so it is possible that they are due to partial melting. The crust may be divided into two layers, the upper and the lower crust, with crustal thickening mainly in the lower crust beneath the NE Tibetan Plateau. The thickness of the lower crust increases from 22 km to 38 km as the crustal thickness increases from 42 km in the Ordos block to 63 km in the Songpan-Ganzi terrane south of the Kunlun fault. Both the Conrad discontinuity and Moho in the Qinling block and in the Haiyuan region are laminated interfaces. The faults and large earthquakes in the Haiyuan region are the result of compression between the Tibetan Plateau and the Ordos block.

142-12 **BTH 25** Li, Songlin

CRUSTAL STRUCTURE OF MAINLAND CHINA FROM DEEP SEISMIC SOUNDING DATA

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Since 1958, about ninety seismic refraction/wide angle reflection profiles, with a cumulative length of more than sixty thousand kilometers, have been completed in mainland China. We summarize the results in the form of (1) a new contour map of crustal thickness, (2) fourteen representative crustal seismic velocity-depth columns for various tectonic units, and, (3) a Pn velocity map. We found a north-south-trending belt with a strong lateral gradient in crustal thickness in central China. This belt divides China into an eastern region, with a crustal thickness of 30-45 km, and a western region, with a thickness of 45-75 km. The crust in these two regions has experienced different evolutionary processes, and currently lies within distinct tectonic stress fields. Our compilation finds that there is a high-velocity (7.1 -7.4 km/s) layer in the lower crust of the stable Tarim basin and Ordos plateau. However, in young orogenic belts, including parts of eastern China, the Tianshan and the Tibetan plateau, this layer is often absent. One exception is southern Tibet, where the presence of a high-velocity layer is related to the northward injection of the cold Indian plate. This high-velocity layer is absent in northern Tibet. In orogenic belts, there usually is a low-velocity layer (LVL) in the crust, but in stable regions this layer seldom exists. The Pn velocities in eastern China generally range from 7.9-8.1 km/s and tended to be isotropic. Pn velocities in western China are more variable, ranging from 7.7 to 8.2 km/s, and may display azimuthal anisotropy.

142-13 **BTH 26** Wysession, Michael E.

SEISMIC EVIDENCE FOR A PIPELINE OF WATER INTO THE DEEP MANTLE

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Evidence from seismic attenuation tomography is presented to show that water is likely traveling with subducted lithosphere into the lower mantle in some regions of Earth. The first-ever whole-mantle 3-D model of shear-wave attenuation shows regions of extremely high seismic attenuation overlying the subducted lithosphere in the lower mantle beneath eastern Asia and western North America. The seismic model was constructed using more than 90,000 seismic shear wave phases taken from the IRIS global database of digital broadband seismograms from 1990 onward. The 3-D attenuation model strongly correlates with patterns of known whole-mantle convection: the low-attenuation anomalies correlate with long-standing regions of paleosubduction, and high-attenuation anomalies correspond to the asthenosphere, spreading ridges, and the Pacific and African megaplumes in the lower mantle. However, the largest high-attenuation anomalies are found in the depth of 700-1300 km beneath eastern Asia and North America, and these anomalies have attenuation values at the same level as the asthenosphere. There is a slight low-velocity anomaly associated with these features, and given this combination, the best explanation is the pumping of water into the lower mantle via subducted ocean lithosphere. Post-serpentinite hydrous phases like hydrous phase D have been found to be stable to depths as great as 1300 km if the temperature stays low enough, which occurs for these fast-subducting slabs. We propose that not all of the water in subducting lithosphere dehydrates in the upper mantle (generating arc magma), but that a small amount remains in the subducted ocean crust and doesn't dehydrate until reaching the top part of the lower mantle.

142-14 **BTH 27** Conrad, Clinton P.

FASTER SEAFLOOR SPREADING AND LITHOSPHERE PRODUCTION DURING THE MID-CENOZOIC

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Concurrent changes in seawater chemistry, sea level, and climate since the mid-Cretaceous are thought to result from an ongoing decrease in the global rate of lithosphere production at ridges during this time. The present-day area distribution of seafloor ages, however, is most easily explained if lithosphere production rates were nearly constant during the past 180 Ma (e.g., Rowley, 2002). We examined spatial gradients of present-day seafloor ages and inferred ages for the subducted Farallon plate to construct a history of spreading rates in each major ocean basin since ~140 Ma, revealing dramatic events during the Cenozoic. Globally, seafloor spreading rates increased by ~20% during the early Cenozoic due to an increase in plate speeds in the Pacific basin. Since then, subduction of the fast-spreading Pacific-Farallon ridge system has led to a 12% decrease in average global spreading rate and at least an 18% decrease in the total rate of lithosphere production by the most conservative estimates. These rapid changes during the Cenozoic defy models of steady- state seafloor formation, and demonstrate the highly time- dependent and evolving nature of plate tectonics on Earth.

142-15 **BTH 28** Lithgow-Bertelloni, Carolina

GLOBAL RECONSTRUCTIONS OF CENOZOIC SEAFLOOR AGES: IMPLICATIONS FOR BATHYMETRY AND SEA LEVEL

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Although accurate estimates of Cenozoic seafloor ages will serve to further our understanding of the relationship between mantle dynamics, plate tectonics, and a variety of surficial geological processes, it is difficult to estimate ages of subducted seafloor. However, given the near-constancy of surface velocities within a tectonic stage, we can estimate Cenozoic plate ages, even for subducted lithosphere. We reconstruct seafloor ages based on the Cenozoic plate reconstructions and absolute rotation poles of Gordon and Jurdy [1986]. For the western Pacific, we explore alternative models based on the reconstructions of Hall [2002]. Both reconstructions indicate an increase in average seafloor age since the early Cenozoic, resulting in an increase in the volume of ocean basins and a decreased sea level since the Early Cenozoic. These trends are more pronounced for the Gordon and Jurdy [1986] reconstruction because the Hall [2002] reconstruction retains older seafloor in the western Pacific, which approximately halves the predicted sea level decrease since the early Cenozoic (250 vs. 125 m compared to geologic estimates of ~150 m). These changes in sea level occur despite decreases in oceanic lithosphere production rates of only about 20% in both models. Thus, the changing distribution of seafloor age has a larger effect on sea level than changes in spreading rates or ridge lengths. These reconstructions can also be used to estimate past heat flow, the volume of subducted buoyancy and changes in the bathymetry of the Cenozoic ocean basins.

142-16 **BTH 29** Black, Ross A.

POTENTIAL FIELD INTERPRETATION ALONG THE SOUTHERN EDGE OF THE MINA DEFLECTION, NEVADA

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East of the Sierra Nevada Block the Walker Lane/Eastern California Shear Zone (WL/ECSZ) currently accommodates about20-25% of the predominantly right-lateral shear associated with the relative motion between the Pacific and North American plates. The central WL/ECSZ is geologically dominated by a regional releasing bend known as the Mina deflection. This right-lateral stepover domain is structurally characterized by a series of curvilinear normal-faults and associated pull-apart basins as well and left-lateral strike-slip faults that together link the regional-scale right-lateral transcurrent shear zones of the WL/ECSZ. Recent potential field studies, along with mapping, and age dating show distinct differences in geological history of the basins along the southern edge of the Mina deflection, including structural style, faulting initiation age, and basin depth. Queen Valley began opening ~3 Ma and is surprisingly shallow, with an average depth of ~0.2 km and maximum apparent depth of ~0.5 km. There is a significant negative gravity anomaly in northern Queen Valley, but it is likely to be attributable to a low-density pluton. This late-Cretaceous pluton is exposed in the northern White Mountains and extends into the subsurface below southern Fish Lake Valley and the SW Silver Peak range. Northern Fish Lake Valley pull-apart began forming at ~6 Ma and is significantly deeper. Gravity data indicate that the main post-Miocene basin fills is on the order of ~1.5 km. It appears to be bounded by NE-trending normal faults along the northern and southern margins and is internally segmented by NNW-trending right-lateral strike-slip faults. Geophysical and structural data suggest that active oblique-slip faults along the eastern side of northern Fish lake Valley have been progressively back-stepping to the east. The active pull-apart basin is superimposed on an older (middle Miocene) structurally-controlled basin that is now largely covered by younger basin fill and by low-density Mio-Pliocene ash-flow tuffs to the north of the pull-apart basin. Farther to the north and east Columbus Salt Marsh and the northern Big Smokey Valley have very large gravity lows associated with them, with no apparent major contribution from low-density plutonic basement. Both valleys appear to be significantly deeper, perhaps up to 1.8 km in depth.

142-17 **BTH 30** Kinabo, Baraka

COUPLED AEROMAGNETIC AND SRTM (DEM) DATA INVESTIGATIONS OF FAULT GROWTH PATTERNS IN INCIPIENT RIFT ZONES

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Digital Elevation Models (DEMs) extracted from the Shuttle Radar Topography Mission (SRTM) are coupled with high resolution aeromagnetic data to investigate fault development during the early stages of continental extension in the Okavango Rift Zone (ORZ), NW Botswana. Aeromagnetic data provide information on fault morphology at depth within the basement, while the SRTM data provide morphological information on surface ruptures associated with these faults. Our results suggest that the ORZ preexisting tectonic fabric of the basement strongly influences the overall geometry of the rifted basins and facilitated the growth and propagation of faults. Fault systems at different stages of development in the ORZ typically display an en-échelon distribution of small right stepping segments ~ 3-25 km in length. Nascent fault systems are characterized by soft linkages, where the overlapping fault segments are linked by ductile strain zones between them. More mature fault systems are characterized by hard linkages, where overlapping fault segments are linked directly by touching of fault surfaces. ORZ is not defined by a well developed border fault system. However, the existing fault system can develop into a main master or border fault for this rift system as evidenced by linkage in two ways: (1) linkage of short individual segments (3-25 km long) to form a single fault (~100-325 km long; second order linkage); and (2) simultaneous linkage of fault segments (~100-325 km long) by development of transfer faults (first order linkage). Paleoclimatic studies suggest that the ORZ is < 40,000 years old and aeromagnetic data reveal that the faults are as long as 325 km. Thus, the propagation of the rift faults is relatively fast, probably due to the strong influence of the pre-existing fabric.

AM

TUESDAY