ples that permit detailed delineation of depositional facies within geomorphic process-oriented motifs (including glacial morphologic sequences, badlands-style topographic inversion, delta plain, coastal barrier/back bay, and a sand/loess provenance model). The surficial geology is visualized in the third dimension through cross sections and block diagrams. The deposit/process link facilitates predictive applications of map information in studies of resources, nutrient and contamination cycling, and choices involving critical ecosystems. Initially compiled by traditional methods, the map was prepared for editing and printing by the creation of digital graphic files.

BTH 36 Kuzila, Mark S.

BARTAK DEPRESSION OR MERNA CRATER - THE ORIGIN OF A LANDSCAPE FEATURE IN CUSTER COUNTY, NEBRASKA

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The loess-covered tablelands of central Nebraska are covered with numerous depressions varying greatly in size. The depressions are generally concentrated in two areas; the Rain Water Basin Area of south-central Nebraska and the Central Nebraska Loess Hills of north-central Nebraska. One large depression is located in Custer County near the town of Merna. The depression is referred to as the "Bartak Depression" by the locals because it is located on property owned by the Bartak family. This depression has been the focus of interest since it was renamed the Merna Crater in the 1997 article "Merna Crater- A young impact feature in loess of Central Nebraska" published in the Oklahoma Geological Survey Circular by Dort, Zeller, Martin and Moody. Dort et al. concluded that the depression was probably created by the explosion of an extraterrestrial bolide which occurred about five kilometers above the land surface. They estimate the explosion occurred about 3000 years ago.

Results of test holes drilled in and adjacent to the depression show that the stratigraphic units including the Peoria Loess (25,000 to 11,000 YBP) carry through the landscape adjacent to and beneath the depression with no disruption. This indicates that the depression was not formed by the explosion of a bolide that occurred about 3000 years ago. The origin of the depression may be similar to that of other depressions found throughout Nebraska.

BTH 37 Tierney, T. E.

MOUNTAIN RANGE SEGMENTATION: AN EXAMPLE FROM THE WESTERN TRANSVERSE RANGES, SOUTHERN CALIFORNIA

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The Santa Ynez Mountains of southern California have a distinct crest along 110km of the range's 130km length, organized into five mountain segments which are geomorphic expressions of differential tectonic rates accommodated by structure. The range provides evidence that linear mountain ranges, as with the faults that forms them, are segmented. As segment length increases, they may overlap or collide to create accommodating structural features such as cross-faults or folds. From west to east, mountain segment #1 is 25km long, with mean elevation of 400m, and an average height:width ratio of 0.06. Mountain segment #2 is 15km long, with mean elevation of 775m, and an average height:width ratio of 0.09. Mountain segment #3 is 25km long, with mean elevation of 1100m, and an average height:width ratio of 0.10. Mountain segment #4 is 25km long, with mean elevation of 1100m and an average height:width ratio of 0.14. Mountain segment #5 is 20km long, with mean elevation of 1250m, and an average height:width ratio of 0.14. Boundary zones between mountain segments correspond with one of the four major structures splaying into the range from the Santa Ynez fault, a major left-reverse structure that partially controls uplift of the range. The easterly-increasing height:width ratio supports the hypothesis that relief is a primary tectonic signal recorded by the landscape. Increasing eastern elevation implies increased shortening in that direction, which is consistent with the hypothesis of clockwise rotation of the western Transverse Ranges, and shortening produced by the big bend of the San Andreas fault. Hypsometric analysis of basins on the south flank of the range yields integral values between 0.38 and 0.58, which are statistically equivalent both among and within mountain segments. Hypsometric equivalence may be explained by: 1 The topography of the five segments formed at about the same time period; 2) tectonic perturbations are slow and their effects are beyond the resolution of the hypsometric method; 3) tectonic processes have been ceased for long enough that basin hypsometry has established an equilibrium.

BTH 38 Duncan, Christopher C.

EXTRAORDINARILY HIGH DENUDATION RATES SUGGESTED BY ^{10}BE AND ^{26}AL ANALYSIS OF RIVER SEDIMENTS, BHUTAN HIMALAYAS

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Exceptionally low activities of ^{10}Be and ^{26}Al in quartz separated from fluvial sediments in the Sunkosh drainage of Bhutan indicate some of the highest mean basin denudation rates yet measured cosmogenically, 0.8 to >12.2 mm/yr. These high rates of denudation are consistent with the topography and climate of Bhutan, which is characterized by the greatest concentration of deeply-incised, steep-gradient channels and the highest rainfall in the Himalayan region. The nuclide data support fission track and incision rate measurements made elsewhere in the region.

We sampled the active channel at two sites in the same basin, split the sand and gravel into 3 grain sizes, and analyzed the fractions separately. One site (X09) is near the downstream end of a drainage network covering a substantial fraction of western Bhutan (8000 km^2, elevation 300 to >7000 m). The second site (1BAL0) is in a small, partly glacierized (<10%) sub-basin far upstream (73 km^2, elevation 4000 to 6500 m). Nuclide activity in five samples ranges from 80,000 to <3000 atoms/g ^{10}Be and 450,000 to <24,000 atoms/g ^{26}Al. The equivalent surface exposure periods are extremely short, ranging from 750 to <50 years (Nishiizumi et al. production rates convolved using basin hypsometry). In samples where measured ratios were finite, nuclide activities are well correlated, with an average ^{26}Al/^{10}Be ratio of 6.0 +/- 0.5.

Interestingly, there appears to be a grain-size dependence. Sand size grains (0.25 to 0.85 mm) gave ^{10}Be and ^{26}Al average model erosion rates of 1.1 and 2.3 mm/yr at X09 and 1BAL0, respectively; clasts >2 mm gave higher rates, >12.2 and >9.6 mm/yr, for two samples from X09 but lower rates for 1BAL0 (0.85 mm/yr). The grain size dependence may indicate differences in sediment delivery mechanisms (e.g., soil creep vs. landsliding), or differences in source proximity with coarser material being more locally derived and hence dosed at elevations where nuclide production rates are different. Alternatively, the grain size dependence may indicate different rates of erosion for areas supplying the coarse fraction.

BTH 39 Naeser, Charles W.

PALEOZOIC THROUGH CENOZOIC UPLIFT, EROSION, STREAM CAPTURE, AND DEPOSITION HISTORY IN THE VALLEY AND RIDGE, BLUE RIDGE, PIEDMONT, AND COASTAL PLAIN PROVINCES OF TENNESSEE, NORTH CAROLINA, VIRGINIA, MARYLAND, AND DISTRICT OF COLUMBIA

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Fission-track (FT) analysis of zircon and apatite is helping define the Paleozoic through Cenozoic history of the Valley and Ridge (VR), Blue Ridge (BR), Piedmont (P), and Coastal Plain (CP) provinces of the Eastern United States. The oldest zircon FT ages from the VR and western BR are significantly older than those of the eastern BR and P provinces. This is apparent in the ranges of both sample ages and single-grain ages.

Province	Stratigraphic age	FT age range (Ma)		
		Weighted mean sample age		Single-grain ages
		Apatite	Zircon	Zircon
VR	Paleozoic	~200	~560	~380-~1160
western BR	Proterozoic-Paleozoic	~100-~155	~315-~920	~235-~1790
eastern BR	Proterozoic-Paleozoic	~95-~185	~265-~380	~200-~730
P	Proterozoic-Mesozoic	~130-~200	~260-~300	~200-~360
CP	Miocene	no apatite	~390	~45-~1340
CP	Cretaceous-Oligocene	~130-~155	~175-~280	~45-~705

Some VR and western BR rocks were never buried deeply enough during the Phanerozoic to obtain temperatures sufficiently high (>~225°C) to totally reset their zircon FT ages. In contrast, most zircon ages from the eastern BR and P show significant cooling from >225°C at ~300-280 Ma, most likely related to emplacement of major Alleghanian thrust sheets. Apatite FT data suggest that BR and P rocks underwent relatively slow, continuous cooling during the Mesozoic and Cenozoic, passing through the apatite FT closure temperature (~90-100°C) at a rate of about 16 m/m.y.

FT ages of detrital zircon in shallowly buried (<411 m) rocks in the CP reflect FT ages in the source terrain. The data suggest that the P and eastern BR were the major source of detritus from Cretaceous through Oligocene time. Old zircons comparable in age to those in the western BR and VR do not appear in CP rocks until early or middle Miocene. Preliminary interpretation is that major drainage from the western BR and VR was to the west prior to the Miocene—major east-flowing Mid-Atlantic rivers did not breach the Blue Ridge until early or middle Miocene time.

BTH 40 Lenz, Brett R.

TIMING AND CHARACTERISTICS OF EARLY HOLOCENE AGGRADATION, COLUMBIA RIVER, WASHINGTON STATE

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Post Wisconsin alluvial stratigraphy of the mainstream Columbia River drainage developed by alternating cycles of alluvial deposition and landform stability. Holocene aggradation episodes followed closely behind the Upper-most Pleistocene catastrophic (Glacial Lake Columbia) floods dated in this study to 12,800+/-50 BP. Initiation of a multiple Holocene fine-grained terrace system commenced prior to 9000 BP and continued through to approximately 500BP. A comparison of stratigraphic sequences reveals that (1) extensive tracts of early Holocene floodplain are preserved along the mainstream Columbia River; (2) there is little variability in the age and character of the early Holocene terrace deposits; (3) sedimentologic and pedologic details of the early Holocene terrace are readily differentiated from later Holocene terraces; (4) early Holocene archaeological sites are commonly buried within the former floodplain. Details of the timing and stratigraphic characteristics of the earliest Holocene alluvial floodplain are presented.

BTH 41 Dethier, David P.

COSMOGENIC ANALYSIS OF THE ROCKY FLATS ALLUVIUM NEAR BOULDER, COLORADO

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Analysis of a 4 m deep soil profile from Rocky Flats Alluvium near Boulder, Colorado shows that nuclide activity decreases with depth, consistent with a variety of interpretive models.

The Rocky Flats is the most extensively exposed older piedmont alluvium in the vicinity of Denver. Correlative alluvial deposits and remnant erosional surfaces extend along the Front Range and tens of km east into the High Plains ca.100 m above modern channels. Stratigraphic and geomorphic relations demonstrate that Rocky Flats Alluvium is younger than middle Pliocene and older than ca. 0.6 Ma. Regional paleontologic evidence and ages inferred from soil carbonate accumulation imply that deposits are early Pleistocene. Most workers suggest that the Rocky Flats and younger alluvial sequences correlate with glaciation in the Front Range, but alluvium in the type area was derived from an unglaciated 48 km^2 catchment.

We collected a 9-sample sequence from the surface to —4.2 m in oxidized, clast to matrix-supported gravel exposed temporarily during realignment of an irrigation canal. ^{10}Be activity in quartz grains from the sand fraction ranges from 3.12 *10^6 atoms/gram in a strongly developed Bt horizon buried 0.25 m below the surface to 0.77 *10^6 at ~3.7 m. The A-horizon sample has lower than expected nuclide activity, consistent with mobile, recently emplaced surface sediment.

Several scenarios constrained by muon production <2% and SL, >60° ^{10}Be production of 5.17 atoms g^{-1} y^{-1} fit the nuclide data equally well. A simple, steady erosion model (3.7 m My^{-1}) and time since deposition of 2 My require high inheritance (2.1 *10^6 atoms g^{-1}), equivalent to source basin erosion of 9.4 m My^{-1}. A no-erosion, exposure model implies deposition of alluvium at 0.2 Ma with inheritance (9*10^5 atoms g^{-1} ^{10}Be), equivalent to source basin erosion at 22 m My^{-1}. Multi-stage models (stable fan surface, episodic erosion and deposition, then stable again) also fit the data well and are supported by geologic and pedologic evidence. The fit of such models is optimized by original deposition at ca. 1.5 Ma, stripping between 0.1