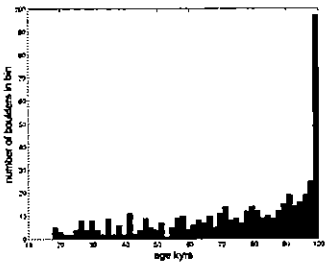
surface degradation model where the moraine flattens and widens with time as fine-grained sediment is transferred down slope from the moraine crest, exposing previously buried boulders there. The Figure shows a typical model result; the exposure age distribution for 500 boulders from a modeled 100 kyrs old moraine surface that has eroded from initial 60 to 29 meters height at the crest. If no erosion took place all 500 boulders would yield the same age (100 ka).

The published boulder age distributions are used to constrain the surface degradation model by finding the least difference between the modeled and observed age distributions. The amount of surface erosion is solved by making appropriate assumptions about the moraine initial form and age of the moraine. The fit between modeled and observed age distributions and the implied erosion rate will be discussed at the meeting.



10:30 AM Gellis, Allen C.

MODERN COMPARED TO GEOLOGIC RATES OF EROSION IN ARROYO CHAVEZ, RIO PUERCO BASIN, NEW MEXICO

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The need to understand how human activities effect natural rates of erosion is essential in defining degraded landscapes. This study examined and compared erosion rate estimates made in Arroyo Chavez (2.28 km²), a subbasin of the Rio Puerco, New Mex., using techniques at two different time scales, the modern and geologic. Between 6/13/1996 - 10/02/1998, 29 to 58 rainfall/runoff events were sampled with sediment traps and small dams. The spatial scale of measurements ranged from 0.76 to 2,280 m². Average erosion rates measured for five geomorphic elements were: gently sloping hillslopes 0.17 mm/yr; mesa 0.29 mm/yr; steep colluvial slopes 0.46 mm/yr; alluvial fan 0.74 mm/yr; and the alluvial valley floor 1.69 mm/yr. Basinwide erosion measured at the outlet of the basin using suspended-sediment data show erosion of 0.78 mm/yr over the 2-years. At the geologic time scale (>10^4 years) sediment production rates for Arroyo Chavez were measured on the geomorphic elements using in situ produced cosmogenic radionuclide 10Be. The 10Be data demonstrate effective fluvial integration where the average 10Be activity measured in the stream channel sediment (1.57 ± 0.18 x 10^5 atoms g-1) is statistically indistinguishable from the 10Be activity measured in the geomorphic elements (0.87 to 1.89 x 10^5 atoms g-1). This similarity indicates a dynamic equilibrium of sediment transport over geologic time; thus, channel sediment nuclide concentrations are representative of basin sediment nuclide concentrations. The basinwide erosion measured with 10Be is 10^2 ± 24 m/Myr (0.1 mm/yr). This geologic rate of erosion plots near the range of values of modern erosion rates (0.11 to 2.93 mm/yr) and indicates that these two independent methods (modern vs. isotopes) are both valid measurement techniques.

The difference in erosion rates between the two methods was most noticeable for the alluvial valley floor, where the modern rate of erosion was as high as 2.93 mm/yr. The alluvial valley floor is grazed and has gas pipeline activity. Can this difference in the geologic scale basinwide erosion rate of 0.1 mm/yr be contrasted to the modern erosion rate on the alluvial valley floor and be used to say that human influences have caused an order of magnitude increase on the alluvial valley in Arroyo Chavez?

10:45 AM Parsons, Anthony J.

A NEW CONCEPTUAL FRAMEWORK FOR MEASURING SOIL EROSION BY WATER

PARSONS, Anthony J.[1], WAINWRIGHT, John[2], POWELL, D. Mark[1], and BRAZIER, Richard E.[2], (1) Geography, Univ of Leicester, University Road, leicester, le1 7rh, United Kingdom, ajp16@le.ac.uk, (2) Geography, King's College, London, Strand, London, WC2R 2LS, United Kingdom

Current estimates of rates of soil erosion by water are incompatible with estimates of long-term lowering of large drainage basins. Here we argue that traditional arguments to reconcile these two disparate rates are flawed and that the problem lies with the methods that have been used to calculate rates of soil erosion. We develop a new conceptual approach that is based upon the travel distances of individual particles. The implication of our study is that previous estimates of rates of soil erosion by water are fallacious.

11:00 AM Matisoff, Gerald

TRANSPORT OF REE-TAGGED SOIL PARTICLES IN RESPONSE TO THUNDERSTORM RUNOFF

MATISOFF, Gerald[1], KETTERER, Michael E.[2], WILSON, Christopher G.[1], and WHITING, Peter J.[3], (1) Department of Geological Sciences, Case Western Reserve Univ, Cleveland, OH 44106-7216, gxm4@po.cwru.edu, (2) Department of Chemistry, Northern Arizona University, Box 5698, Flagstaff, AZ 86011-5698, (3) Department of Geological Sciences, Case Western Reserve University, Cleveland, OH 44106-7216

Fundamental to evaluating the success of agricultural management practices and understanding the delivery of sediments to downstream waters is the transport distance of eroded particles. The downslope transport of rare earth element-tagged soil particles eroded during a spring thunderstorm was studied at both a natural prairie and an agricultural field in southwestern Iowa. Soils are a silty loam developed on loess. Natural soils were tagged with the rare earth elements Eu, Tb and Ho to ~1000 ppm via coprecipitation with MnO2. Tagged material was replaced in three target locations; surficial soil samples were collected following precipitation and runoff; and rare earth element concentrations were determined by inductively coupled plasma mass spectrometry. Diffusion and exponential models were applied to the concentration-distance data to determine particle transport distances. The results indicate that the concentration-distance data are well described by the diffusion model, but the exponential model does not simulate the rapid drop-off in concentrations near the tagged source. Using the diffusion model, calculated particle transport distances at all hillside locations and at both the cultivated and natural prairie sites were short, ranging from 3 to 73 cm during runoff from a single storm. REE concentrations were below detection limits at a weir at the downstream end of the field. The short transport distances indicate that the majority of particles were retained on the landscape and were not delivered to the stream. Erosion control methods implemented in the watershed should be reflected quickly in downstream waters.

11:15 AM Shroder, John F.

SOIL EROSION ON THE CHEYENNE RIVER SIOUX TRIBAL (CRST) RESERVATION, SD: NATURAL VERSUS HUMAN

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Severe soil erosion of the Pierre Shale has occurred on the old Armstrong Gunnery Range (GR), which was rented at minimum cost from the Lakota Nation during WWII. Erosion is thought to have resulted from prehstoric natural sheet and gully activity, overprinted by erosion from the drought years of the 1930s, overgrazing by non-Indian cattle companies uncontrolled by Bureau of Indian Affairs (BIA), landslide and wave attack along the Lake Oahe impoundment of Missouri and Cheyenne rivers, and subsequent government inattention. Surrounding non-GR tribal lands were thought to be much less eroded, but this is shown to be somewhat inaccurate. This study for the U.S. Army Corps of Engineers (COE) was contracted for assessment of types, locations, and degrees of soil erosion in the GR as part of environmental cleanup of a formerly utilized defense site. Extensive sheet and rill erosion, headcuts and gully erosion, stream incision and increase in sinuosity, wave erosion, slope failures of complex earth fall, topple, slump, and flow, and minor wind mobilization of shale fragments are characteristic. The most effective methods of analysis were GIS manipulation of SCS-mapped soil types (especially shale lands and alkaline slickspot complexes), geomorphological mapping of erosion types, and chronology construction of long term soil erosion and alluvial deposition. Spatial and temporal distribution of soil erosion in the area conforms to a complex response by a wide variety of causative factors. Responsibility for soil erosion is spread between natural and human agencies, with BIA, COE and CRST as the main human agents. Environmental justice to CRST indicates that some measured governmental remediation is advisable.

SESSION NO. 122, 8:00 AM

Wednesday, November 7, 2001

T67. Archaeological Geology and the Pleistocene-Holocene Transition (*GSA Archaeological Geology Division*)

Hynes Convention Center, 206

8:00 AM Davis, Loren G.

STATUS AND FUTURE OF GEOARCHAEOLOGICAL RESEARCH ON THE PLEISTOCENE-HOLOCENE TRANSITION IN THE COLUMBIA RIVER PLATEAU, WESTERN NORTH AMERICA

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Historically, archaeological and geoarchaeological research in the Columbia River Plateau has produced a rich record of human occupation dating to the Pleistocene-Holocene transition. In recent decades, however, geoarchaeological research in the Plateau has lagged behind other areas of North America leaving many important issues unresolved and underexplored. By discussing the current state of geoarchaeological knowledge of the Pleistocene-Holocene transition in the Plateau, a foundation is set for suggesting future directions in research. These directions include strengthening the late Pleistocene-early Holocene radiocarbon chronology, conducting additional and more detailed paleoenvironmental and paleoecological studies in lowland settings, and developing a comprehensive stratigraphic framework for alluvial systems.

8:15 AM Dort, Wakefield, Jr.

ALPINE ENVIRONMENTS OF HUMANS AT THE PLEISTOCENE-HOLOCENE BOUNDARY IN IDAHO AND ADJACENT AREAS

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In the 1960's Earl Swanson and associates excavated archaeological sites in Birch Creek Valley, east-central Idaho, mainly rock shelters on the flood plain margin and in lower reaches of tributary canyons in the flanking Lemhi and Beaverhead Mountains. These sites had considerable depth, yielding cultural material at least as old as 10,500 - 11,000 14C yr BP. Concurrently and continuing, Dort and students studied regional environments that affected these early people.

The Lemhi crest averages about 11,000 feet elevation. Most major, east-facing valleyheads were occupied by glaciers in late Pinedale time (ca. 12,000 14C yr BP). Summits and upper interstream divides must have had perennial snowfields and even ice carapaces. High alpine areas were thus available to Paleoindians, and trans-mountain travel was effectively blocked. The floor of Birch Creek Valley was nearly as arid as it is now; trees were generally absent, although mountain slopes were forested. Glaciers retreated mainly be sublimation; meltwater streams were minor.

This local situation was part of a regional pattern. The 80-mile-long Lemhi Range had at least 250 definable glaciers, mainly on its eastern, sheltered side. Glacierization of other high ranges in Idaho was closely similar. So also in adjacent states, e.g., the Wind River Mountains were nearly buried by ice. Interacting chronologies of maximum expansion of Pinedale Glaciers, not everywhere synchronous, with local arrival times of humans determine specific affects. In any event, remnant glaciers were still present well after the first people appeared.