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QUATERNARY II
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№ 13410

HOLOCENE PALEOWINDS IN THE MOJAVE DESERT RECORDED BY ROCK VARNISH DATING OF VENTIFACTS: GREENHOUSE ANALOG?

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The mapping of ventifact groove trends on large boulders and bedrock outcrops in the Mojave Desert provides a record of near surface strong wind circulation. Accelerator-radiocarbon and cation-ratio dating of rock varnishes formed on these grooves provides close minimum ages for the cessation of aeolian abrasion, from the mid-Holocene to the present.

Three radiocarbon (R) and 9 cation-ratio (CR) dates are available at this time. All are minimum-limiting estimates for the end of aeolian abrasion. WNW facing ventifacts at Tortoise Hill, SE of Ludlow, yield varnish ages of 5.5. ± 0.6 ka (CR), 5.6 ± 0.5 ka (CR), and 6.0 ± 0.1 ka (R). A SE facing ventifact at the same site is 3.6 ± 0.3 ka (CR). Similar ventifacts in the Cronese Basin yield ages of 5.4 ± 0.3 ka (CR), 4.5 ± 0.1 ka (R), 5.1 ± 0.3 ka (CR), 5.4 ± 0.4 ka (CR), and 5.3 ± 0.6 ka (CR). Ventifacts on the Amboy Lava Flow yielded ages 2.7 ± 0.3 ka (CR) and 2.5 ± 0.1 ka (R), whereas those on the Pisgah Lava Flow are < 0.3 ka (CR).

Based on this preliminary ventifact data set, and on the evidence of dune building episodes in the Cronese basin and vicinity, it appears that aeolian activity was more active in the Mojave Desert in the mid-Holocene. The nature of aeolian abrasion contains time- and space-transgressive elements, with some areas experiencing a cessation of abrasion while others continue to remain active.

These results demonstrate that a thorough mapping and dating of mid-Holocene ventifacts would provide a unique regional record of near surface strong wind paleocirculation. If the period before about 5000 years ago was a time of greater global warmth, this regional paleocirculation record could prove to be a valuable analog to a greenhouse earth.

№ 20471

BARIUM CONCENTRATION IN ROCK VARNISH: IMPLICATIONS FOR CALIBRATED ROCK VARNISH DATING CURVES

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Cation-ratio dating is an effective means of dating a variety of geomorphic surfaces, utilizing a ratio of minor cations [(K+Ca)/Ti] in rock varnish. Although this ratio is directly related to the Ti concentration, it can also be affected by the presence of Ba that may be analytically included in the recorded concentration of Ti.

Ba is a minor constituent found in virtually all rock varnishes sampled from southern Nevada including the Lake Mead area, Las Vegas Valley, and the Yucca Mountain region. Ba is heterogeneously distributed in rock varnish, both with depth in the varnish and laterally across the varnish surface. Ba concentrations appear greater in younger varnishes (<100 ka) than in older varnishes (>500 ka), and they are greater in varnishes on topographically low surfaces than in varnishes on hillslope or ridge deposits.

The presence of Ba in rock varnish is problematic when the analyses are by energy dispersive spectroscopy (EDS), where the Ti K-alpha and K-beta peaks overlap the Ba L-alpha and L-beta peaks, respectively. Unless the overlapping lines are decomposed, a part of the Ba L-alpha peak is recorded as a component of the Ti K-alpha peak, yielding an erroneously large value for Ti. In order to evaluate the effect of Ba concentration on our Yucca Mountain rock-varnish dating curve we have utilized both a quantitative EDS program (MICROQ) with the scanning electron microscope and a wavelength-dispersive analyzer with the electron microprobe to derive Ti values that are unaffected by Ba. Small amounts of Ba do not yield a Ba L-alpha peak large enough to change significantly the value of the calculated varnish cation ratio (VCR). The effect of Ba on calculated VCRs is most pronounced for younger varnish samples, where Ba concentrations are high, resulting in calibrated rock varnish dating curves with too low a slope for the young part of the curve.

№ 1787

ROCK VARNISH, ALLUVIAL FANS, AND TECTONISM IN THE SOUTHERN OWENS VALLEY, CALIFORNIA

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We are using geologic mapping, remote sensing, relative dating techniques, and rock varnish analyses to constrain the history of fan aggradation and tectonism in the southern Owens Valley.

Bouldery deposits adjacent to Lone Pine Creek, a perennial stream draining a formerly glaciated basin in the Sierra Nevada, extend eastward up to 10km from the range front. An unusual sequence of stream capture events has isolated and preserved alluvial fan surfaces of four distinct ages. Comparison with chronosequences studied on other Sierran fans suggests that the surfaces at Lone Pine range in age from Holocene to perhaps Tahoe.

The younger fans are composed predominately of poorly stratified, poorly sorted, matrix-supported diamictons probably deposited by debris flows. Limited exposures in older fans suggest that a greater percentage of these deposits are clast-supported and are likely of fluvial origin. All deposits contain a predominance of granodiorite and aplitic clasts derived from the Mount Whitney pluton.

A scarp of the Lone Pine Fault of the Owens Valley Fault Zone offsets at least two of the fan surfaces (Lubetkin and Clark, 1988). In addition to using our age estimates for offset fan units, we are using thermoluminescence, varnish radiocarbon, and varnish cation-ratios to constrain the timing of movement on this fault scarp.

№ 24416

PALEOCLIMATIC IMPLICATIONS OF CHLORIDE PROFILES: APPLICATIONS FOR TOXIC WASTE DISPOSAL AND LONG-TERM GROUND WATER PROTECTION, WHISKY FLAT AND BEATTY, NEVADA

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Chloride mass balance (CMB) was used at Whisky Flat and Beatty, Nevada to determine the impact of long-term climatic change on ground water recharge rates and percolation depths. Availability of paleoclimatic information permitted reconstruction of qualitative changes in effective precipitation which could be compared with rates and depths determined from the CMB method. CMB results support earlier interpretations of increased effective precipitation in the Pleistocene. In addition, two subsurface moisture studies at Beatty drew similar conclusions regarding percolation depths.

Six sites at Whisky Flat and one at Beatty were cored and analyzed for distribution of chloride with depth. High, intermediate, and low chloride concentration zones appeared in each chloride profile. Recharge rates for Whisky Flat, based on the low concentration zone, are 0.04-0.8 mm/yr. 0.8 mm/yr is interpreted as representing the maximum recharge rate possible through the alluvial sediments under conditions of increased effective precipitation. Recharge is limited to the upper 9 m at Beatty.

High chloride concentrations occur at the Beatty site at 1.75-4.5 m and at Whisky Flat in the upper 7.7 m. This zone probably records the maximum depth of root influence during the Pleistocene. Intermediate chloride concentrations occur from 4.5-7.7 m at Beatty and from 7.7-9.6 m at Whisky Flat. This is interpreted as recording the most frequent depth of deep percolation prior to the change in vegetation which proceeded to concentrate chloride higher in the profile. The two zones indicate a lag time between the changes. Thus, sediments above 9.6 m at Whisky Flat and 7.7 m at Beatty occur within the long-term, hydrologically active zone. Sediments below are within a hydrologically semi-stable zone. In both areas, recharge appears to have been minimal to nonexistent, even under the wetter Pleistocene climate.

№ 24497

LATE QUATERNARY AEOLIAN GEOMORPHOLOGY OF THE DALE LAKE SAND SHEET, MOJAVE DESERT, CALIFORNIA

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The Dale Lake Sand Sheet consists of a series of climbing dunes deposited against the southwest flank of the Sheephole Mountains in the southern Mojave Desert. Several ephemeral streams have dissected the sand sheet exposing the underlying sediments. The latter exhibit significant paleosols and other weathering horizons. The largest of the "dune wadis" is about 2 km long, 90 to 100 m wide at its contact with the bedrock, and up to 40 m deep. The surface of the sand sheet is mostly stabilized by vegetation and veneered with rock talus from the adjoining mountains.

Geomorphic and sedimentological analysis of aeolian sediments, combined with scanning electron microscopy (SEM) of quartz-grain characteristics, suggest 6 to 8 dune-building episodes during late Quaternary time. It is likely that at least 4 aeolian episodes have occurred since the last Wisconsinan glacial maximum around 18 ka, with peak deposition during earlier Holocene time, followed by reduction of aeolian activity and the formation of rock varnish around 5 ka. One major episode, with several depositional pulses, probably occurred between 8 and 5 ka.

The dune-building episodes most probably follow significant climatic transitions, such as the Pleistocene-Holocene transition during which atmospheric conditions changed from cool and wet to hot and arid. The various aeolian sediments accumulated largely in response to the lowering of water levels in lake basins and a consequent increase in fine sediment availability, and to stronger and more persistent winds.