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Testing cosmogenic nuclide production rate scaling models using in situ cosmogenic ^14C from surfaces at secular equilibrium: Preliminary results

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A cornerstone of applications utilizing in situ cosmogenic nuclides is the ability to scale production rates from the few sites where they are well established to sites under study. Theoretical scaling models currently used for this purpose (e.g., Lal, 1991, EPSL 104, p. 424; Dunai, 2001, EPSL 193, p. 197) are based on modern measurements of cosmic ray variation with latitude and altitude. However, these models have never been thoroughly tested empirically using significant numbers of geologic samples. The main problem in addressing this issue is the scarcity of

samples of well-established age. However, the recent development of a reliable extraction method for in situ cosmogenic ^14C (in situ ^14C) from quartz (Lifton et al., 2001, GCA 65, p. 1953) provides a unique opportunity to test these theoretical models empirically. Unlike other commonly used in situ cosmogenic nuclides, ^14C has a short half-life that allows attainment of secular equilibrium, or "saturation," in approximately 20 ky. Also, ^14C loss from decay far outstrips loss from erosion in many geomorphic settings. Under such conditions, the measured concentration of in situ ^14C is only a function of its integrated average production rate. These aspects of the in situ ^14C system make a wide range of landscape features suitable for production rate determinations. We have sampled a mid-latitude altitude transect to assess the altitudinal dependence of integrated late Quaternary in situ ^14C production rates. Sampling site altitudes range from near sea level in Death Valley, CA, to nearly 3.9 km in the Inyo-White Mountains, CA. Low-altitude samples were collected from sites on stable alluvial fan surfaces exhibiting well-developed desert pavements, while high-altitude samples were collected from stable bedrock sites with low local relief. Preliminary results are consistent with both the Lal (1991) and Dunai (2001) scaling models, which do not differ significantly along the transect. A significant muogenic ^14C component (Heisinger et al., 2002, EPSL 200, p.357) is not resolvable within the uncertainties of these data. We also plan to present data from saturated surfaces at other latitudes and altitudes to assess further the applicability of published scaling models over the late Quaternary.

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