CRONUS-Earth: Half-way to the destination

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In-situ cosmogenic nuclides are widely and increasingly used for to study earth-surface processes and its recent history, but these goals have been impared by inconsistencies in the understanding of the production systematics. The CRONUS-Earth Project was funded by the U.S. National Science Foundation with the objective of reconciling these discrepancies and providing a generally accepted basis for interpreting cosmogenic nuclide data. The Project is approximately half-way through its five-year duration and has achieved significant progress toward these goals. Areas of considerable uncertainty that have seen major advances include samples for ^{36}Cl production-rate calibration and spatial/temporal scaling of production. New paleomagnetic reconstructions have become available to complement improved scaling theory, resulting in testable predictions of global production patterns. The relation between geologically-based and neutron-monitor based scaling has been elucidated through monitoring of neutron-monitor-response physics. Calibration samples have been collected in a rigorous fashion from sites associated with the shoreline of Lake Bonneville, Younger Dryas glacial sites in Scotland, and LGM glacial sites in the Puget Lowland of Washington State, a locality of particular importance for resolving discrepancies in ^{36}Cl production. Essential data and tools include improved production cross sections from neutron beam experiments and the release of a web-based cosmogenic calculator for the community.

Extraction of biosignatures from weathered basalts

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There is a growing interest in the bio-load in weathered volcanic rocks. The relevance extends to Mars, where there are extensive regions of weathered basalt. Any bio-load in such rocks is likely to be very low, so it is essential to maximize the extraction efficiency for analysis. Analysis of suites of regolithic Tertiary (~60 Ma) basalt from Skye, Scotland, show the importance of particle size for optimal organic recovery.

Basalt from two localities was divided into fine (<500µm)- and coarse (>1cm)-grained fractions and surface contamination removed using acetone. They were then crushed and sieved into five different grain size fractions and subsequently soxhlet-extracted for 48 hours with 93:7 DCM/methanol.

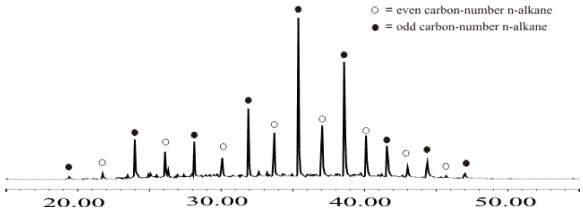
The data show that a reduction in grain size results in a higher yield of extractable organic material (EOM) (Table 1). The n-alkane odd-over-even preference (OEP) exhibited by the GC-MS trace (Fig. 1) indicates that the extract is thermally immature, consistent with a recent biological (microbial) signature.

Table 1: EOM (%) for different grain size fractions.

Glen Varradale basalt			**Quiraing basalt**	
	CG[a]	FG[b]	CG[a]	FG[b]
>425µm	0.001	0.002	0.002	0.005
425-125µm	0.001	0.004	0.001	0.006
125-63µm	0.002	0.005	0.003	0.006
63-38µm	0.002	0.005	0.004	0.007
<38µm	0.003	0.007	0.004	0.007

[a] Coarse-grained; [b] Fine-grained

Figure 1: GC-MS trace of the saturate fraction *m/z* 85 ion from the Quiraing basalt. Note marked OEP of n-alkane peaks.



The data emphasise the importance of analysing a fine grain size during processing of samples, including future Mars missions, where volcanic rocks may be targeted.