High-precision U-Series measurements of ca. 600,000 year old corals

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Coral reefs are important archives of past climate change because they grow close to the sea-surface and can be absolutely dated using U-series techniques, providing valuable information on both sea-level and temperature fluctuations. However, robust climate records based on the U-series dating of coral reefs are sparse before the last glacial cycle, due to a progressive loss in resolution of the U-series chronometer as one goes further back in time, coupled to a lack of well-preserved dateable material. To address the latter, U-series open-system models have been devised, which attempt to remove the diagenetic component from conventional U-series age determinations.

Using a Nu Plasma multiple-collector ICP-MS, equipped with multiple-Faraday protocols, we are able to date ~300 thousand year old (ka) corals with age uncertainties of ±1 ka and ~600 ka samples with age uncertainties of better than ±15 ka (2σ) [1-3], compared with previous error limits that are up to a factor of ten larger. Using these methods, we have previously reported initial U-series measurements for a suite of >500 ka corals from Henderson Island, an emergent atoll in the south-central Pacific Ocean [4]. Henderson Island's fossil corals show extraordinarily little diagenetic alteration for their age and the best-preserved sample yields a U-series age of 600 ± 15 ka (2σ).

We have extended this work by dating additional samples, including an extensive suite of multiple sub-samples from the same corals. This new dataset allows us to further constrain the timing of the Marine Isotope Stage (MIS) 15 interglacial period. Furthermore, given the high-precision of the measurements and the extreme old age of the samples near the upper limit of the U-series chronometer, these data have important implications for understanding mechanisms of diagenetic alteration in fossil reef systems, and for assessing the reliability of U-series open-system models of diagenesis.

[1] Andersen *et al*. (2004) *Int. J. Mass Spec*. **237**, 107-118. [2] Potter *et al*. (2005) *Int. J. Mass Spec*. **247**, 10-17. [3] Stirling *et al*. (2007) *EPSL* **264**, 208-225. [4] Andersen *et al*. (2008) *EPSL* **265**, 229-245.

Development of lunar highland regolith simulants, NU-LHT-1M, -2M

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As part of a collaborative agrement between the U.S. Geological Survey (USGS) and NASA's Marshall Space Flight Center (MSFC) lunar highland simulants are being produced to support engineers and scientists in developing the technologies required to put a base on the moon by 2024. Two simulants have been produced to date: NU-LHT-1M and -2M (NASA/USGS-Lunar Highlands Type-1&2 Medium-grained). Using starting material chiefly collected from the Stillwater Mine, Nye, MT, blending protocols were developed based on normative mineralogy calculated from average chemistry for the Apollo 16 regolith. New technologies using a high temperature remotely coupled plasma melter were developed to generate both high quality and agglutinitic glasses that simulate the glassy components of the regolith. Detailed chemical, mineralogical and physical properties analysis of NU-LHT-1M indicates that it is overall a good surrogot for highlands lunar regolith (our new simulant LHT-2M has not be analyzed yet). The primary difference between 1M and 2M was the inclusion of trace mineralogy (phosphates and sulfide). Plans will also be presented on the future direction of the simulant project.

Mineral	% of total
Olivine	2.7
Altered Ol	0.5
Cpx	2.1
Opx	4.0
Plagioclase	31.6
Ilmenite	0.4
Chromite	0.1
Glass	16.0
Agglutinates	40.9
Other	1.7

Table 1: Mineral composition LHT-1M.