WEATHERING EFFECTS IN THE HOLBROOK METEORITE AND THEIR POSSIBLE REMOVAL.

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Following several loud explosions, at around 7:15pm on the evening of 19th July 1912, the Holbrook meteorite fall spread thousands of small samples over a wide area near the Arntz siding of the Santa Fe Railroad in Arizona, U.S.A. Many specimens were collected at the time, but not everything, because previously overlooked fragments of this L6 group meteorite were recovered in 1931 and 1968. In fact a hundred years after the event 'rockhounds' organise successful collecting activities on an annual basis. The Holbrook meteorite is therefore almost unique in that samples with a common origin, having different degrees of weathering under similar climatic conditions, are available.

Earlier this year we carried out a study of four samples of Holbrook collected over a 99 year interval to investigate any relationship between their oxygen isotope composition and the time they had been exposed to weathering in the terrestrial environment [1]. We found a regular increase in $\delta^{18}O$ (*ca* 4.7 to 5.4‰) with date of collection. Subsequently, we have been able to obtain a number of additional samples found since 1980 which have provided additional evidence in support of a positive correlation between $\delta^{18}O$ and year of collection. The samples also show a small but regular decrease in $\Delta^{17}O$ values (0.1 ‰) demonstrating exchange or addition of terrestrial oxygen.

It is well known that ordinary chondrites weather *via* reactions occurring between water and iron metal and Fe^{2+}containing minerals [2]. It appears from our data that the most important source of water is not precipitation but the residual soil surface water which is highly fractionated due to evaporation. Whilst the actual processes going on are not yet clear, we believe there is an important spin-off potentially available as a result of this study.

Most meteorites available for laboratory investigation have been collected as 'finds' as opposed to observed 'falls'. As a consequence their oxygen isotope composition has been compromised, sometimes severely, by weathering. A number of reagents including dilute HCl or ethanolamine thioglycollate (EATG) [3] are currently used to selectively remove weathering products, with the aim of ensuring that oxygen isotope measurements on meteorite 'finds' more closely reflect the pristine pre-atmospheric entry composition of the sample. By treating similar sized samples of Holbrook collected at different times, i.e. with a different degree of weathering under similar circumstances, we hope to improve the current methodologies for treating weathered meteorites. We are also investigating a number of other examples of meteorite falls with variable collection dates in order to extend the results obtained from Holbrook.

References: [1] Pillinger C. T. et al. 2013. Abstract # 2883. 44th Lunar & Planetary Science Conference. [2] Lee M. R. and Bland P. A. 2004 GCA 68, 893-916. [3] Greenwood R.C. et al. GCA 94, 146-163.

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