WEATHERING EFFECTS IN THE AXTELL, CV3 CARBONACEOUS CHONDRITE. P.A. Bland\(^1\), F.J. Berry\(^2\) and C.T. Pillinger\(^1\). \(^1\)Planetary Sciences Unit, Department of Earth Sciences, \(^2\)Department of Chemistry, The Open University, Milton Keynes, MK7 6AA, UK.

Abstract: Based on its weathering characteristics Axtell may be considered to be a new CV3 carbonaceous chondrite. It appears to have spent at least 10000 years weathering on Earth before it was found.

Until meteorite samples were regularly returned from Antarctica and hot deserts, virtually all the carbonaceous chondrites known in museum collections were observed falls. Therefore it is unusual when a CV3 chondrite reportedly found in the 1940s suddenly becomes commercially available. The fact that the specimen is alleged to have been discovered at Axtell in Texas, not particularly far from where the Allende shower provided copious amounts of CV3 material in 1969, tends to arouse suspicion. The Axtell meteorite has an oxygen isotopic composition identical to Allende and a \(^{26}\)Al activity typical of chondrites, but a \(^{60}\)Co lower than might be expected if it were a piece of Allende masquerading as a new CV3(1). Low \(^{60}\)Co activity is not proof of a new sample since a sample from close to the pre-atmospheric surface of a meteorite like Allende would also have diminished \(^{60}\)Co(1).

Consistent with being a genuine find, and unlike Allende, Axtell is weathered (2). At the present time we are undertaking a programme of studies to characterise the weathering products of meteorites, as a function of their terrestrial age, by Mössbauer Spectroscopy (3). In order to see if we can provide information regarding the authenticity of Axtell, we have conducted a Mössbauer study of an appropriate specimen. For comparison we have also analysed a piece of Allende recovered within a few days of its fall and material from Acfer 082 a weathered CV3 returned from the Saharan desert.

Samples of meteorite (ca. 1g.) were crushed in an agate mortar under acetone to minimise oxidation during grinding. Approximately 0.5g of powder, enough to afford an area of 1.25 cm\(^2\), was sandwiched between two layers of adhesive tape and \(^{57}\)Fe Mössbauer spectra recorded at 298\(^{\circ}\)K using a \(^{57}\)Co/Rh source.

Raw Mössbauer spectra (as opposed to curve fitted data) are shown in the Fig. The data obviously indicate that Allende is the least weathered of the three meteorites examined. Acfer 082 appears to be slightly more weathered although it is still quite fresh when compared to other desert ordinary chondrite samples (4). The sample of Axtell is clearly the most weathered of all three meteorites: the Mössbauer spectrum indicates a significant amount of paramagnetic Fe\(^{3+}\) (akaganéite, lepidocrocite or small-particle goethite) probably makes up 30-40\% of the total iron signal in this meteorite. We note that in an experiment we performed in the laboratory with an ordinary chondrite, to simulate Antarctic weathering, it took 160 days in contact with water to achieve 40\% Fe\(^{3+}\).
Whilst it remains a possibility that in a situation of exceptionally rapid weathering the oxidation observed in Axtell could have resulted over a 25 year timescale (i.e. that this meteorite is a tampered with fragment of Allende), our comparison with Acfer 082 and the laboratory data suggests that this is extremely unlikely. Therefore, on the basis of a characterisation of weathering produced phases, we conclude that Axtell is a new CV3 meteorite presumably with a relatively long terrestrial residence time. Data obtained for Roosevelt County ordinary chondrites would imply at least 10000 years (3).

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References: