A HIGH VOLTAGE ELECTRON MICROSCOPY STUDY OF ORANGE SOIL 74220 OR "WHERE HAS ALL THE IRON GONE".

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The orange soil, 74220, has been suggested to have originated from 1) impact on either a solid crust, or 2) liquid lava, 3) from fire fountaining or 4) vapor condensation. The hypothesis of origin by impact has been tested by high voltage electron microscopy (HVEM); the experiment also allowed establishing constraints on the size and distribution of the magnetic phase. The assumptions for the test are as follows: HVEM studies of class A breccias (no recrystallization in glass-crystalline matrix) has indicated that all the Fe is fine-grained (single domain or superparamagnetic) whereas that in the recrystallized rocks is coarse-grained (multiple domain) (1,2). Similar work on a set of experimentally shocked Apollo 16 soils shows that the Fe remains in the fine-grained condition over the range of shock pressures covered, but that there is an increase in the amount of Fe present in the 250kb range (3). Our observations on these shocked specimens shows an increase in magnetic (bcc) Fe in the finely dispersed particles of the glassy phase (Fig. 1). Therefore if the orange soil originated by shock one might expect to find a finely dispersed phase of bcc Fe, which could be observed by electron microscopy.

Experimental Procedure: A specimen of orange glass, 74220, was obtained from P.M. Bell, the same specimen from which absorption spectra were obtained (4). The glass sphere (0.3 mm dia.) was ion thinned and examined at 800 kV in both bright field (Fig. 2) and dark field (Fig. 3) electron microscopy and by electron diffraction (Fig. 4). Approximately 500 sq. microns of the sample were electron transparent.

Results: No finely dispersed phase, bcc iron phase (or magnetite (4,5)) was present in the area studied. Particles 50Å or greater would certainly have been detected. The presence

of larger particles, with a distribution of less than 2×10^5 particles/cm^2, are not precluded by this negative result.

Discussion: The observed magnetic properties of the orange glass presumably arise from large multidomain particles (6) rather than small dispersed particles. The absence of dispersed particles, which we believe increase with shock intensity, places doubt on the origin of the orange soil as a product of impact on a solid crust.

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HVEM -- Orange Soil

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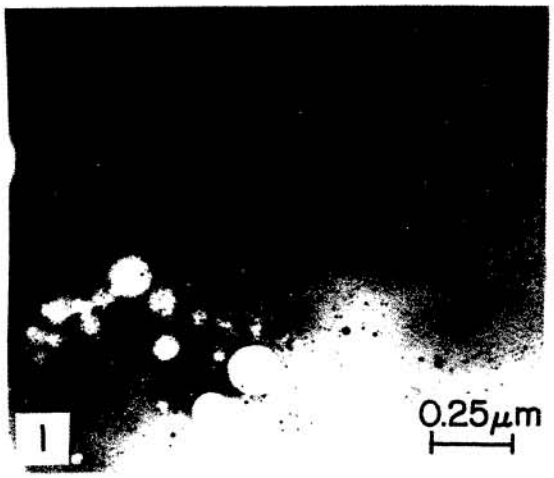
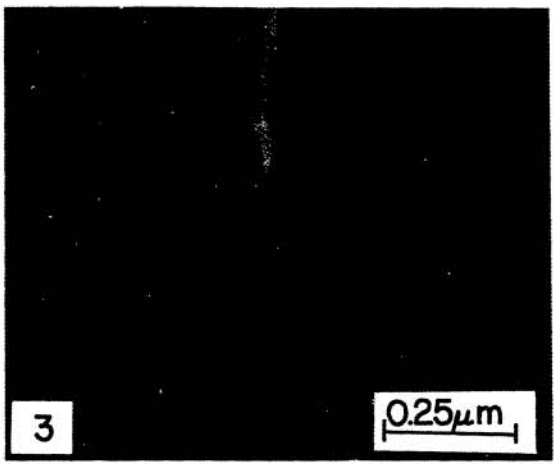
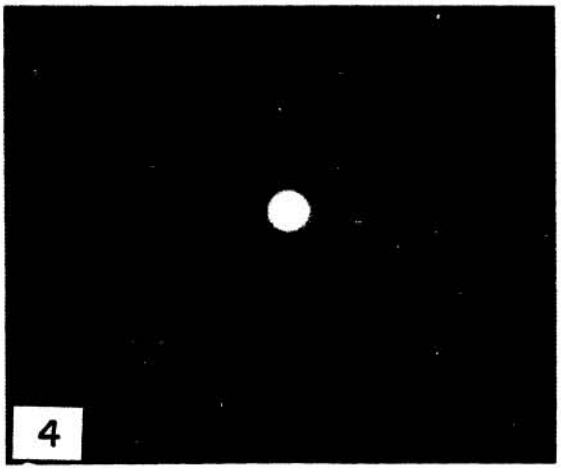


Dispersed fcc and bcc Fe particles, crystal fragments and pores. 250 kb, 65010 soil.

Bright field electron micrograph 74420 glass, 800 kV.



Dark field electron micrograph, 74420 glass. The black area is a hole.



Electron diffraction -- orange glass 74420, showing diffuse ring.