Alumina and mullite ($Al_6Si_2O_{13}$) bricks in electric arc steel furnaces breakdown in the hot face surfaces to form dendritic hibonite in glass, anorthite, and hercynite; CaO and FeO are added from furnace slag (Buist, 1968). Whereas these refractory bricks are simpler in composition than CAI inclusions, the thermal alteration textures are very similar to CAI rims.

We conclude from the above observations and data, that CAI inclusions crystallized from liquids and were involved in at least one shock episode. A later reheating event partially melted the margins of these inclusions to form devitrified or layered rims. Partial melting of CAI inclusions may have resulted from ablation with an Fe-rich nebular gas cloud or impact-derived dust cloud. All events pre-dated allende matrix implacement.

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Wark, D.A. and J.F. Lovering, 1977. *Proc. Lunar Planet. Sci. Conf. 8th*, 95-112.

AMAK CRATER: PROBABLY METEORITIC

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Amak Crater (C.N. = 55°44′N; 163°09′W) is a probable meteorite impact crater with rim-rim diameter of 160 m and greatest depth 21.3 m. The crater is emplaced on a bench or terrace of unsorted sediments ranging from boulders to sand-size grains. This terrace ends at a wave-cut cliff which actually sections part of the crater. Thin volcanic ash beds in the cliff face show stratigraphic relationships; from these it is seen that the SE rim is raised. It is not obvious that the SW rim is correspondingly raised, but the section observed in that quadrant is almost tangential to the structure. Topographically, the crater has prominent raised rims except in the SW quadrant and at the south side, where erosion has removed the outer rim flank and the rim crest. The crater surface and surroundings are completely covered with a well-developed soil and extremely dense vegetation which made visual search for meteorite fragments or impact products impossible. Suspected iron-shale particles were collected along the base of the cliff at places where they would accumulate if they had weathered out of the near-surface sediments at the top of the cliff. These specimens were found only in the vicinity of the crater. No impactites were noted. Topographic and magnetic maps were constructed in order to better understand the form and structure of the crater.

U AND Pb ISOTOPES IN ALLENDE INCLUSIONS AND METEORITIC WHITLOCKITE

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We measured the isotopic composition of U and Pb in five Ca-Al rich inclusions from the Allende and in phosphates from the St. Sévérin chondrite and the Angra dos Reis achondrite. The purpose of this study is to test claims of large isotopic anomalies in U from meteoritic materials made by other workers. Many of the Allende inclusions analyzed here show excess $^{26}Mg^*$ in phases with high $^{27}Al/^{26}Mg$ ratios. Samples of Allende inclusions were dissolved in HF, HC1, and HNO_3, leaving an insoluble residue which consisted almost exclusively of spinel. The U isotopic results are shown in Figure 1 where $\delta^{235}U$ represents fractional deviation of the measured ratio from the nominal ratio $(^{235}U/^{238}U)_{\oplus} = (1/137.88)$ in parts in 10^3. The error bars represent $2\sigma_m$. It is clear that all five samples have U isotopic composition similar to the normal value within limits of error. The $^{206}Pb/^{204}Pb$ ratios measured on the coarse grained inclusions range from 63 to 226. The calculated $^{207}Pb/^{206}Pb$ model ages range from 4.557 to 4.568 AE, which indirectly substantiates the observation of normal U by direct measurements.

The U isotopic compositions on both pure (Wh-1, > 99%), and less pure (Wh-3, ~ 95%) whitlockite samples separated from the St. Sévérin chondrite are shown in Figure 1. These results are also indistinguishable from normal. The observed $^{206}Pb/^{204}Pb$ ratios on St. Sévérin whitlockite range from 144 to 178 and the calculated $^{207}Pb/^{206}Pb$ model ages range from 4.550 to 4.553 AE. The U isotopic composition on a whitlockite separate (99% pure) from Angra dos Reis (Fig. 1) is also normal. The observed $^{206}Pb/^{204}Pb$ ratio is 302 and the $^{207}Pb/^{206}Pb$ model age is 4.553 AE. In summary, the U isotopic composition in Allende inclusions and meteoritic whitlockites either determined by direct measurements or inferred from $^{207}Pb/^{206}Pb$ ratios are indistinguishable from the normal value. The results of this study complement the conclusions of our previous report (*Geophys. Res. Lett.* **7**, 275-278, 1980) that the $^{235}U/^{238}U$ value in meteoritic materials analyzed by us so far is similar to that in lunar and terrestrial materials. These results are in complete disagreement with the reports by Tatsumoto *et al.* (1980) of the existence of large variations in the isotopic abundance of U in meteoritic samples including the St. Sévérin whitlockite. While there

may yet be variations in $^{235}U/^{238}U$, they are not present in the materials so far studied at the level of 5‰. We can as yet provide no positive evidence for the existence of ^{247}Cm in the early solar system in large amounts.

Div. Contrib. No. 3460 (354).

Tatsumoto *et al.*, 1980. *Lunar Planet. Sci. XI*, 1125-1127.

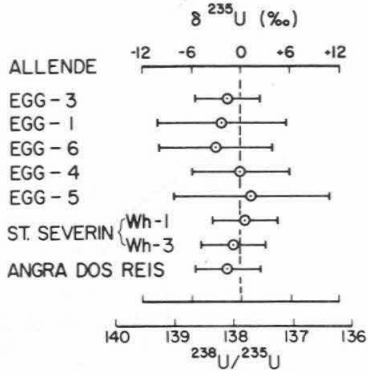

Fig. 1

THE BOUVANTE EUCRITE

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On July 30, 1978, a stony meteorite (8 kg) was found at Bouvante (Drôme), probably a short time after its fall. It is the third fall of a eucrite (a rather rare class of meteorites) in France.

Few thin veins cut through the meteorite. Crystals have been broken rather than deformed by shock. Rare fine grained cm-sized clasts were observed in the otherwise ophitic matrix. The mineralogy consists of about equal amounts of plagioclase and pyroxene. Minor minerals are chromite, ilmenite and quartz. Traces of metal, troilite, whitlockite and zircon have been detected. The plagioclases are zoned and are slightly more alkali-rich (an. 70-90) than usually found in eucrites. Pyroxenes have rather constant Mg-concentrations (10-11% MgO), while Ca and Fe contents show considerable variations. Very thin exsolution lamellae are observed in the pyroxenes. The SiO_2 excess is partly visible as quartz between pyroxene and feldspar laths, together with fine-grained iron-rich pyroxene, and small blebs of iron and troilite. A few zircon crystals, associated with ilmenite, could account for relatively high levels of various trace elements as measured by INAA.

Chemical analyses of Bouvante both from Mainz and Paris, indicate that the concentrations of major, minor and trace elements are in the range of other eucrites. With 15.1% Fe Bouvante belongs to the Fe-rich end of the eucrite range, possibly representing partial melts from the interior of the eucrite parent body (Stolper, 1977). The light REE are higher in Bouvante than in any eucrite analysed so far (6.1 ppm La in Bouvante; 5.3 ppm in Stannern and 3.0 ppm in Juvinas). There is also marked negative Eu anomaly, similar to that observed in Stannern or Nuevo Laredo. Light REE are slightly enriched relative to heavy REE. Therefore Bouvante may represent an even smaller degree of partial melting than Stannern [4% of partial melting (Consolmagno and Drake, 1977)]. The low Co content (around 5 ppm) is also typical for eucritic melts, having equilibrated with a metal phase.

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