URANIUM-LEAD AND LEAD-LEAD RATIOS IN LUNAR SAMPLES 66095 and 12013 BY ION MICROPROBE MASS ANALYSIS, J.R. Hinthorne and C.A. Andersen, Hasler Research Center, Applied Research Laboratories, Goleta, CA 93017

The "rusty rock" 66095 is important to the interpretation of lunar surface processes because the high volatile element contents (1) (including thallium and lead unsupported by either thorium and/or uranium) could be the result of either lunar outgassing or of a carbonaceous chondrite meteorite impact (2). Our ion microprobe studies of probe mount 66095,81 have demonstrated that the thallium and lead are localized in distinctly different areas of the rock, suggesting that Tl and Pb may not have had the same origin. Thallium concentrations (a few ppm) are found to be associated only with Ni-Fe grains which are of probable meteoritic origin (2), and the unsupported lead is found in several areas rich in chlorine and iron similar to the goethite-chloride-sulfate regions found associated with troilite alteration rims (2). No thallium, uranium or thorium was detected in these areas enriched in lead. The 207/206 and 208/206 ratios of the lead found in four such Cl-rich areas are given in Table I. The approximate abundances of ^{206}Pb in the regions analyzed (30-40 μm) are also given.

TABLE 1
ISOTOPIC RATIOS OF Pb ASSOCIATED WITH Cl IN 66095,81(±1 std. dev.)

SPOT #	207/206	208/206	ppmw ^{206}Pb
1	1.01+/-.15	0.98+/-.14	2
2	0.91+/-.22	1.28+/-.27	5
3	1.26+/-.26	1.78+/-.33	4
4*	0.89+/-.05	2.00+/-.09	35

*The possibility that this is contamination Pb has not yet been ruled out.

Leaching experiments (3) have shown that lead similar in isotopic character to that in Table 1 is released from a bulk sample of 66095 by water and dilute acid washes. Thus, the easily leachable lead of reference (3) is possibly associated with the goethite and Cl-rich regions of troilite alteration as is the lead given in Table 1. This would indicate that the leachable leads had the same origin as the Cl, S and OH, of the alteration region, i.e. the source is a carbonaceous chondrite impact (2) rather than the moon itself (3). Further leaching of 66095 with strong acids (3) produced lead of a more radiogenic character and also produced the major fraction of Th and U contained in the rock. The phases being dissolved by the strong acids are probably the kinds of minerals in which the U and Th are concentrated during crystallization--phosphates, zircon, zirconolite, tranquillityite, etc.(4,5). Presently, we are attempting to locate such U-rich phases in 66095 so that radiogenic lead crystallization ages may be determined.

Additional microanalysis of individual uranium-bearing phases in the light-colored portion of 12013,14 (a polished probe mount) confirm our previous lead 207/206 for this material (4). Figure 1 shows a concordia plot of our new uranium-lead data for a uranium-rich Zr-Nb-Y(-Ti?) oxide phase found

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in a narrow, light-colored vein cutting the dark portion of the samples in area 46/P in (6). The small correction for modern lead has been necessary because of lead contamination of the polished probe mount.

Our Pb-Pb and U-Pb ages for this mineral grain closely match the concordant data of (7) for fragment #45 of the light-colored part of 12013. The close correlation of these ages for the single mineral and bulk material is further confirmation of a common origin for the vein and the rest of the light material. Measurements are in progress to determine additional U-Pb and Pb-Pb ages in the dark material and possibly locate phases in both the light and dark portions from which there has been some loss of radiogenic lead as suggested by (7).

Further evaluation of our Pb-Pb data on 15555, 14310 and 68415 indicates that the apparent systematic error of about 70 m.y. previously reported (5) with respect to Rb/Sr, K/Ar and Ar/Ar methods on the same rocks is essentially eliminated by using the more accurately determined decay constants for uranium summarized in (8): $\lambda^{235} = 9.485 \times 10^{-10} Yr^{-1}$ and $\lambda^{238} = 1.5525 \times 10^{-10} Yr^{-1}$. These decay constants have been used in calculating the ages reported on Figure 1.

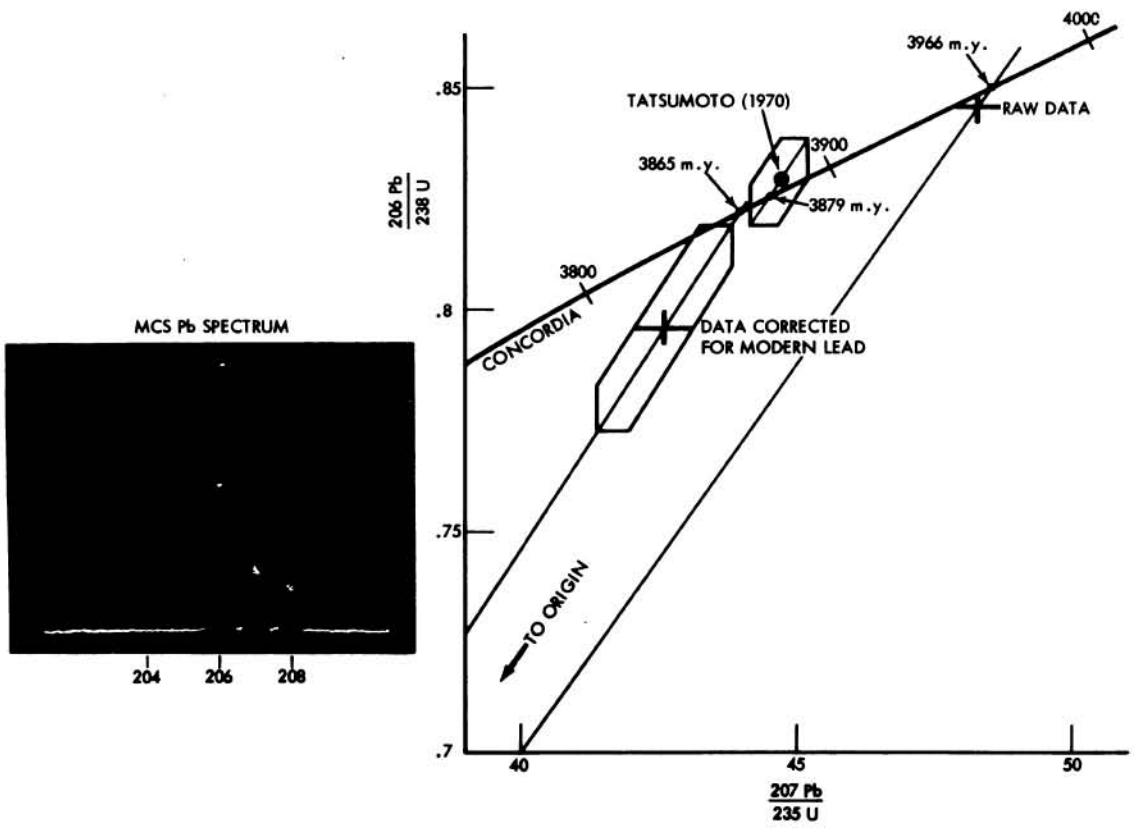

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FIGURE 1: Concordia diagram of U-Pb data for a single mineral grain in a narrow, light-colored vein in 12013. Crosses are ion microprobe data with 1 standard deviation indicated for the corrected data point. The data of Tatsumoto (7) have recalculated with the decay constants in (8). The raw lead data as accumulated by the ion microprobe and stored in a multichannel scaler, MCS, (full scale is 10^3 counts per channel) is also shown in the figure.

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