Sm-Nd AND Rb-Sr AGES FOR MIL 05035: IMPLICATIONS FOR SURFACE AND MANTLE SOURCES.

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Introduction: The Sm-Nd and Rb-Sr ages and also the initial Nd and Sr isotopic compositions of MIL 05035 are the same as those of A-881757 [1]. Comparing the radiometric ages of these meteorites to lunar surface ages as modeled from crater size-frequency distributions [2,3] as well as the TiO₂ abundances and initial Sr-isotopic compositions of other basalts places their likely place of origin as within the Australe or Humboldtianum basins. If so, a fundamental west-east lunar assymmetry in compositional and isotopic parameters that likely is due to the PKT is implied.

Sm-Nd age: The Sm-Nd age (TSm-Nd) = 3.80±0.05 Ga for MIL 05035 (Fig. 1) and agrees within mutual error limits with TSm-Nd = 3.87±0.06 Ga for A-881757 [1]. Initial εNd = +7.2±0.4 for MIL 05035 compared to +7.4±0.5 [1] for A-881757.

Rb-Sr age: The isochron values are TRb-Sr = 3.90±0.04 Ga and ISr (initial 87Sr/86Sr) = 0.699089±0.000014 (Fig. 2). The Rb-Sr age reported by [1] for A-881757 is 3.89±0.03 Ga when adjusted to λ(87Rb) = 1.402 x 10⁻¹¹ y⁻¹ in excellent agreement with the MIL 05035 value. ISr = 0.69910±0.00002 for A-881757 [1] also agrees well with the MIL 05035 value.

Discussion: The Sm-Nd and Rb-Sr data as well as Sm-isotopic data not given here suggest that MIL 05035 and A-881757 are isotopically identical. The internal Pb-Pb isochron age reported by [1] for A-881757 was 3.94±0.03 Ga, whereas the 206Pb/204Pb Ar age was 3.80±0.01 Ga. Recent 39Ar-40Ar age measurements [4] gave younger ages of 3.69±0.07 Ga for A-881757 and 3.71±0.11 Ga for Yamato-793169, thought to be launch-paired with A-881757. Y-
the age data, but seems less likely for reasons given below.

Lunar basalt ages [5] are plotted vs. the longitude of the known or estimated (YAM, LAP 02205 [6]) sampling sites in Fig. 3. Comparing Fig. 3 to Fig. 12 of [2] summarizing mare basalt ages by the crater size-frequency method shows both similarities and differences. Crater size-frequency ages are lacking for cryptomaria corresponding to some A14 breccia clast ages, and Luna 16 and Luna 24 sampling sites, i.e., the maria Fecunditatis and Crisium, respectively. The sampled L-24 basalts are VLT basalts with TiO2 abundances about half the TiO2 abundances of the YAM basalts (Fig. 4.). TiO2 in Mare Crisium ranges ~1-8% [7]. Candidate surface units for the YAMs in Mare Humorum [2] correspond to spectral units hDSP and mISP of [8] with estimated TiO2 of ~3.5-5.0 and <~3 wt. %, resp. More recent estimates for the same areas [7] are ~8-9 and ~5-8 wt. %, resp.; higher than TiO2 ~ 2 wt. % for the YAMs [9]. Also, the Humorum basin lies within the boundaries of the Procellarum KREEP Terrain (PKT) [10], and basalts from the PKT have relatively high ISr values in contrast to the YAM and L-24 basalts.

The YAM basalts differ from the L-24 basalts by having higher ISr values in contrast to the YAM and L-24 basalts. Low ISr for MIL 05035 and A-881757 shows derivation from a lunar mantle source with a low Rb/Sr ratio compared to the sources of basalts sampled during the Apollo missions. Similarly, low source region Rb/Sr ratios were found only for basalts from the eastern maria Fecunditatis and Crisium sampled by the Luna 16 and Luna 24 missions [11, 12].

The YAM basalts derived from the L-24 basalts by having higher ISr values as for the ISr data, the εNd values may be used to estimate 2-stage model source region 147Sm/144Nd ratios (Fig. 6). Those data show the mantle source of the YAM basalts to be very LREE-depleted. Thus, the YAM source was deficient in LREE as well as K-correlated Rb, both characteristic of the urKREEP lunar differentiate. Also, the YAM source is characterized by very low 238U/204Pb [1].

**Figure 3.** Estimated source 87Rb/86Sr for lunar basalts vs. longitude of known or estimated sampling sites.

**Figure 4.** TiO2 contents of lunar basalts vs. longitude of known or estimated sampling sites.

**Figure 5.** Summary of information obtained by converting ISr values to source region 87Rb/86Sr ratios via a 2-stage model. Low ISr for MIL 05035 and A-881757 shows derivation from a lunar mantle source with a low Rb/Sr ratio compared to the sources of basalts sampled during the Apollo missions. Similarly low source region Rb/Sr ratios were found only for basalts from the eastern maria Fecunditatis and Crisium sampled by the Luna 16 and Luna 24 missions [11, 12].

**Figure 6.** Estimated source 147Sm/144Nd for lunar basalts vs. longitude of known or estimated sampling sites.

**Conclusions:** The YAM basalts are the products of early melting of sources composed mainly of olivine and orthopyroxene [1], early cumulates in a magma ocean model. The absence of urKREEP from their sources suggests that melting was not due to radiogenic heating. The probable absence of urKREEP-enriched reservoirs beneath the eastern maria suggests an asymmetry in lunar mantle compositions related to the PKT.

**References:**