A CHEMICAL STUDY OF KABA (CV3 CHONDRITE) INCLUSIONS. Y.-G. Liu and R. A. Schmitt, Depts. of Chemistry and Geology and The Radiation Center, Oregon State University, Corvallis, OR 97331.

While most meteoritic studies of unique inclusions have concentrated on Allende, several works on Kaba have been published [1-5]. Kaba may be more primitive in terms of their chemical and mineralogical properties [3-5]. This abstract reports preliminary results on a chemical study of Kaba inclusions (KIs) and matrices (KMs).

Twenty KIs (22-684μg), most of them fine-grained, as well as two chondrules and two matrix samples were picked from two fragments (1.4g total), obtained from Dr. Andrew Graham, British Museum (Natural History). Care was taken to scrape off adhering matrix to KIs. Groups of individual KIs were activated for 14 hours in a thermal neutron flux of $\sim 3X10^{12}$ $n/cm^2/sec$ followed by counting samples, transferred to new polyvials, on both Ge(Li) and 5-mm planar intrinsic Ge (LEPD) detectors. Short 10m activations at $\sim 9X10^{12}$ $n/cm^2/sec$ were done on 11 KIs and one KM.

The REE + Sc pattern of KI33 is shown in Fig. 1. Sixteen KIs have similar flat LILE patterns ranging from 0.6 to 3.6X total Cl. Low REE and small sample weights for some KIs (∿100 μg or less) prevent accurate determination of more REE in these samples. Seven of these 16 KIs were also analyzed for Ti, Al, Mg, Ca, Mn and V. Ranges of Al and Ca are 1.3-3.0% and 0.6-2.8%, respectively. They are not Ca and Al-rich inclusions. The elemental abundances relative to total Cl are plotted in Fig. 2. Generally flat patterns are observed suggesting an uniform condensation. Fe and Mn are depleted relative to Cl.

Four inclusions, KI4, KI31, KI34 and KI39 are Ca and Al rich (see Fig. 2). Their REE patterns are plotted in Fig. 3. KI4 shows an enrichment of HREE relative to LREE with the depletion of both Eu and Yb. These characteristics are very similar to Murchison MH-115 reported by Boynton et al. [7]. It is believed that Group II inclusions formed in the second stage from a gaseous phase in which the ultra-refractory elements had been depleted in the first stage condensation. The enrichment of more refractory HREE, the depletion of more volatile REE, Eu and Yb, and the general decreasing tendency from ultra-refractory to moderately volatile elements in Fig. 2, all suggest that KI4 formed at the first condensation stage at higher temperature than Group II inclusion formed. Comparing with MH-115, the Eu and Yb abundances in KI4 are less depleted, and exhibit less profound Ce and Tm depletions than observed in MH-115. Also, the overall enrichment factors relative to Cl are much lower relative to MH-115 enrichments. Boynton et al. suggested MH-115 may represent the first 1% of solid matter to condense from the solar nebula.

KI31 shows an unfractionated REE pattern within 1σ error with a negative Eu anomaly and a possible negative Yb anomaly. This pattern resembles Allende Group III REE patterns, but with Sc depleted by ∿5X relative to the REE. The condensation temperature for Sc is 48°K and 64°K higher than Lu at 10^{-3} and 10^{-9} bars, respectively [8]. We suggest that KI31 formed in a nebular environment in which the elements more refractory than Lu had been depleted significantly. To test this hypothesis, the abundances of other ultra-refractory elements such as Hf are needed, and are obtainable from activation in a higher neutron flux.

KI34 has a fractionated REE + Sc pattern depleted in HREE. If the abscissa were REE + Sc radii (e.g. VI or VIII coordinated), a straight line would pass through all the data points of KI34 within their 1σ errors.

Such monotonic REE + Sc fractionations are suggestive of monotonic REE + Sc loss to equilibrating pyroxenes. KI39 shows a flat REE + Sc pattern with a positive Eu anomaly which resembles a Group I pattern.

A chondrule, KC4, was analyzed. The REE pattern (Fig. 1) is flat at ∿2.7X C1 which is within the range of Allende and Mokoia chondrules [1,6]. The REE + Sc pattern of the average of two KM samples is shown in Fig. 1 with a factor of 1.4X relative to total C1.

In conclusion, this study of KIs, KCs, and KMs associated with matrix and minerals perhaps more "primitive" than those present in Allende, indicates that a large variety of physico-chemical conditions were present in the early turbulent solar nebula and that some similar and some different conditions apparently existed in the Kaba parental gaseous volume relative to the parental gaseous volumes for components of other C2 and C3 chondrites.

Additional Kaba inclusions are currently being studied via INAA. Many of the unique KIs, KCs and KMs reported in this study and other unique Kaba specimens will be studied by min-pet-EMP-IMP in collaboration with other PIs.

References: [1] Osborn et al. (1974) G.C.A., 38, 1359-1378. [2] Peck (1983) Met. 18, 373-374. [3] Peck (1984) L.P.S., XV, 635-636. [4] Fegley and Post (1985) E.P.S.L., 75, 297-310. [5] McSween (1977) G.C.A., 41, 1777-1790. [6] Schmitt and Smith (1968) In: Origin and Distribution of the Elements (Ed. L.H. Ahrens) Pergamon, pp. 273-282. [7] Boynton et al. (1980) L.P.S., XI, 103-105. [8] Kornacki et al. (1986) E.P.S.L., (in press).

Fig. 1

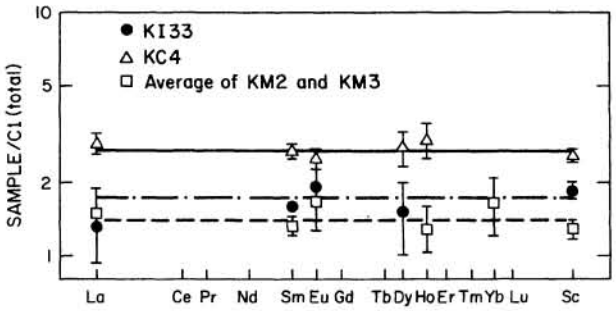

Fig. 2

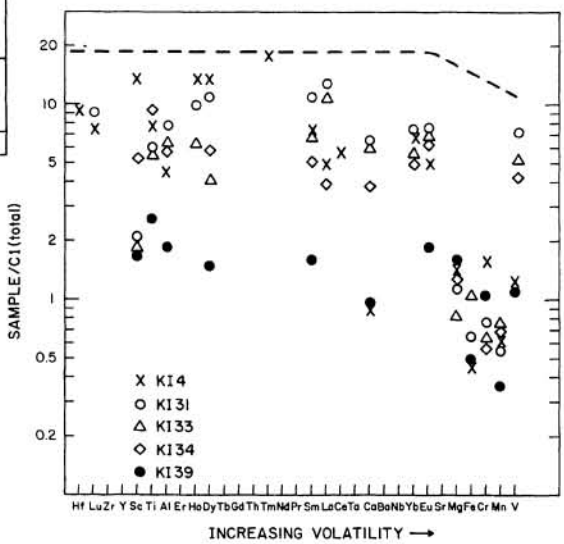

Fig. 3