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THE AL RAIS METEORITE: A CR CHONDRITE OR CLOSE RELATIVE?; G.W. Kallemeyn, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90024, USA.

Although the classificational group 'CR' was first put forth by McSween (1979) more than 10 years ago, it included only the Al Rais and Renazzo meteorites. It has only been the relatively recent discovery of several CR-related chondrites in Antarctica and the Sahara that has provided the necessary research material for an extensive group description and classification (Weisberg et al., 1993); Bischoff et al., 1993). Some 22 separate specimens representing at least 6 falls are now purportedly members of the CR group. In light of all this new data, an old question can once again be raised as to whether or not Al Rais should be classified in the same distinct group as Renazzo.

A previous compositional study by Kallemeyn and Wasson (1982) showed that Al Rais and Renazzo are probable members of the same clan, possibly related to the CI clan, based on similarities in refractory lithophile element abundances. They concluded, though, that the low volatile abundances of Renazzo (≤CV chondrites) relative to Al Rais (mid CM-CV range) precluded their placement in the same distinct group. Recently, Weisberg et al. (1993) presented petrographic evidence supporting the inclusion of Al Rais in the CR group, claiming that the volatile differences are the result of differences in abundances of matrix and/or dark inclusions.

We now have compositional data on five CR chondrites in addition to data on Al Rais and Renazzo. CI-normalized refractory (Al, Sc, Ca, REE, V) and common nonvolatile (Mg) lithophile abundances are very similar among all the chondrites studied, close to CI levels. Refractory siderophile (Os, Ir, Ru) and common siderophile (Fe, Ni, Co) abundances are also very similar amoung all the chondrites. Volatile lithophile abundances (Mn, Na, K) show small differences between the different chondrites, but the abundances in Al Rais are always highest. Among the volatile siderophiles and chalcophiles, abundances in Al Rais are distinctly higher than those in Renazzo and the Antarctic chondrites which cluster together. These differences in volatile abundances cannot simply be attributed to differences in abundances of matrix and dark inclusions. Abundance data for nine volatile elements (including data for El Djouf from Bischff et. al (1993)) shows no distinct correlation with matrix and dark inclusion abundances among the CR chondrites studied.

A very useful method for distinguishing between all known chondrite groups is a comparison of Zn/Mn and Al/Mn atom ratios. On such a plot the Antarctic CR chondrites and Renazzo group together closest to the CO chondrites (to which they have no petrographic similarity) and are quite distinct from Al Rais which plots close to the CM group. The carbonaceous chondrite groups also show a strong correlation between Ga and Sb abundaces. Al Rais plots between the CM and CO groups on such a plot, distinctly separate from Renazzo and the other CR chondrites which plot together in the CK-CV range.

Whole-rock oxygen isotope data for Al Rais (Weisberg et. al, 1993) also show it different from Renazzo and the other CR chondrites. The $\delta^{18}O$ value for Al Rais is nearly 5‰ higher than the closest CR chondrite (Renazzo). This is as

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great as the range shown by all of the CR chondrites. The Al Rais whole-rock oxygen isotope data does not fall on a line fit through Renazzo and the other CR chondrite whole-rock data. But the Al Rais data does fall on an extention of a line fit through CK-CO-CV whole-rock data.

The petrographic data for Al Rais and the CR chondrites (Weisberg et. al, 1993) also show distinct differences. The metallic Fe-Ni in Renazzo the other CR chondrites (~0.7) is twice that in Al Rais. The difference in the (matrix+dark inclusion)/chondrule ratio between Al Rais (1.85) and the nearest CR (1.06) is nearly twice the range shown by Renazzo and the other CR chondrites.

In nearly every case of differences in taxonomic properties, the new CR chondrites from the Antarctic and Sahara, tend to either cluster around Renazzo. None cluster around Al Rais, or even fall in the hiatus between Al Rais and Renazzo. It would appear that Al Rais should not strictly be classified as a CR. Although it is closely related to the CR chondrites in some ways, this relationship is probably no more than that between an LL chondrite and an L chondrite.

References: Bischoff et. al (1993) Geochim. Cosmochim. Acta., in press. Weisberg et. al (1993) Geochim. Cosmochim. Acta., in press.