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HIGH-TEMPERATURE OXYGEN ISOTOPE EXCHANGE BETWEEN METEORITE SAMPLE AND WATER VAPOR: PRELIMINARY EXPERIMENTAL RESULTS.
Y. Yu[1], R. H. Hewins[1], R. N. Clayton[2], and T. K. Mayeda[2], [1]Department of Geological Sciences, Rutgers University, Piscataway NJ 08855, USA, [2]Enrico Fermi Institute, University of Chicago, Chicago IL 60637, USA.

Chondrules in carbonaceous and ordinary chondrites show slope-1 mixing lines on the O three-isotope diagram, suggestive of a gas-melt exchange process during chondrule formation. In order to test this conjecture and extend our existing knowledge of chondrule thermal history and the kinetics of reaction of interstellar dust with solar nebula gas, an experiment involving high-temperature O isotope exchange between a ^{16}O-rich sample (meteorite) and water vapor (terrestrial) has been designed.

The experiment was conducted with a DELTECH vertical tube furnace with ceramic parts shielded with metal foil. The starting meteorite powder (one of two C3 carbonaceous chondrites, bulk Allende and Ornans) was pressed into a pellet and suspended at the hot spot inside the furnace. The furnace gas was a mixture of H_2O vapor and H_2 (1 atm total pressure, $fO_2 = IW - 0.5$) [1]. The preliminary experiments were performed at 1400°C for durations from 5 min to 36 hr, and were terminated by quenching the samples into liquid N. The meteorite charges and the water samples collected were later analyzed for their O isotope compositions.

The experimental results (Fig.1) show that the exchange process has greatly modified $\delta^{18}O$ and $\delta^{17}O$ for both meteorites, which move toward the projected equilibrium point as the heating time increases. For Allende samples, the exchange proceeds quickly in the first 5 min, which accounts for most of the isotope exchange (~84% of total change in $\Delta^{18}O_{A-W}$, and ~57% of total change in $\Delta^{17}O$). Then the exchange is dramatically slowed down, and takes at least 12 hr to finally reach equilibrium with the ambient water vapor. The approach to equilibrium is not a straight line on the three-isotope graph, possibly due to the presence of residual ^{16}O-rich solids in the molten sample. A similar exchange profile is observed for Ornans samples. However, it takes longer for the Ornans sample to reach equilibrium after the initial fast exchange. The 15-hr run for Ornans is still away from the TF line.

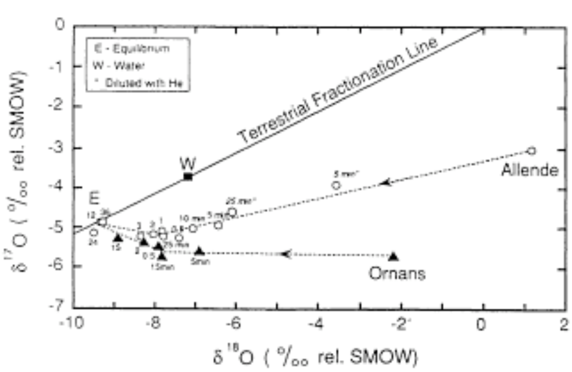

Fig. 1.

Microscopic and electron microprobe studies on the heated Allende and Ornans samples (parallel runs) show that the quenched charges are composed of olivine relics and glass. The initial fast exchange observed is probably due to the rapid exchange between the ambient gas and the molten part of the meteorite sample, and the existence of olivine crystals eventually slows down the exchange process because of its much lower rate of oxygen diffusion [2].

The concentration of exchangeable gas molecules in our experiments is much greater than that in the solar nebula. The next step of this study will be experiments at higher temperatures, under conditions more similar to the chondrule-forming environment, such as flash heating and with gas diluted with Ar to obtain fewer O molecules.

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METAL PRECURSORS AND REDUCTION IN RENAZZO CHONDRULES.
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The positive Co-Ni correlation and Cr, P contents of metal in CR chondrites have generally been taken to indicate their primitive nature, probably inherited from condensation [1,2]. Silicon in the metal of primitive chondrites has also been reported and interpreted as a condensation heritage [3,4]. However, Cr, P, and Si (dissolved or in the form of inclusions) in metal of any CR chondrule generally fall within a ±10% range, though large interchondrule variations exist [5]. We have shown that Cr and Si in metal are in equilibrium with Fo and En in silicates, due to the reducing conditions that prevailed during chondrule formation [6]. In the present paper, we show that the Co-Ni trend was also established during chondrule formation out of heterogeneous precursor material with a variable Co/Ni ratio.

Chondrules in Renazzo are classified as highly molten (HM), in which metal has been expelled to form a mantle outside the chondrule, medium molten (MM), with metal inside and at the periphery and with evidence for grain coalescence, and little melted (LM), in which metal is only present in the form of small blebs dispersed among the silicates.

In HM chondrules, Ni and Co concentrations are extremely homogeneous, comparatively low, and in the cosmic ratio. In LM chondrules, quite the opposite is true: Ni and Co spread over a large range and the amount of scatter increases with decreasing degree of melting of the chondrule. In addition, they do not correlate along the cosmic ratio, but show a negative correlation if any. This heterogeneity is present not only from grain to grain in these chondrules, but also in individual metal grains. Such a heterogeneity is also exhib-

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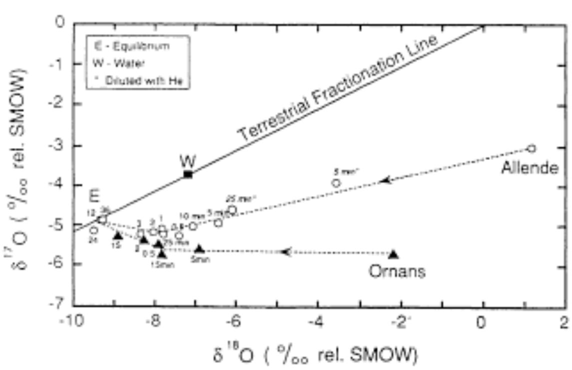

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