shock-blackened, partly glassy (L); unequilibrated (type 3) chondritic (L); light-colored micro-porphyritic melt rock (L); and chondrule-free tridymite-low-Ca pyroxene material. Although macroscopically similar to a regolith breccia (light-dark structure), Kendleton does not contain solar wind implanted gases (3He 3.25, 4He 840, 20Ne 0.84, 21Ne 0.77, 22Ne 0.87, 36Ar 6.8, 38Ar 1.34, 40Ar 5300, 84Kr 0.10, 132Ne 0.14, in 10-8cc STP/g; also Taylor and Heymann, 1969). The rock was not appreciably outgassed and reheated during or after lithification, as indicated by 36Ar contents and lack of reaction between clasts and dark, chondritic matrix. There are no extensive rock-wide shock effects (only minor shock veins), although certain constituents and clasts are highly shocked.

The dark chondritic matrix consists of relatively homogeneous olivine and somewhat heterogeneous low-Ca pyroxenes: means in 9 sections are Fa 21.9-23.3, Fs 15.1-18.6. PMD of FeO in olivine is 0.9 to 3.7 (excluding one Fa6 grain), indicating type 4. Kendleton is unique in that it is mostly (about 80%) made of dark, chondritic matrix whose olivine and pyroxene compositions indicate heterogeneities on a thin section scale. δO^{18} (4.64) and δO^{17} (3.45) indicate L classification. Round to angular, *light-colored chondritic clasts* (the light portions of typical light-dark structured chondrites) have olivine of Fa 23.5 ($\sigma = 0.16$) and low-Ca pyroxene of Fs 19.2 ($\sigma = 2.5$); chondrules are less well-defined than those in the dark, chondritic matrix. Thus, these clasts are type L5/6. *Shock-blackened, partly glassy clasts* are angular to irregularly-shaped, up to 15 mm in size, and are the dominant clast type; boundaries are sharp to diffuse. They consist of faint, isolated to grouped chondrules; shock-melted Fe,Ni and FeS; glassy material; and olivines and pyroxenes with means in 5 clasts of Fa 22.2 - 24.2 and Fs 15.8 - 20.1. δO^{18} (4.88) and δO^{17} (3.70) are consistent with L classification. One clast contains a relict type 3 clast. This *unequilibrated (type 3) clast* has slightly turbid, igneous glass and mean olivine of Fa 18 (N = 35, $\sigma = 8.9$) and low-Ca pyroxene of Fs 15.9 (N = 14, $\sigma = 6.1$). One barred olivine chondrule has Fa 1-19.9. A *light-colored microporphyritic clast* has subhedral to euhedral olivine (mean Fa 21.9, N = 45, $\sigma = 0.27$), in a matrix of devitrified glass. This melt rock clast is depleted in Fe,Ni and FeS and equilibrated prior to rock lithification. A *tridymite-low-Ca pyroxene clast*, 6mm in size, has no chondrules and consists of a large area of tridymite, intergrown with small and adjacent large low-Ca pyroxene (mean Fs 20.0, N = 29, $\sigma = 1.0$). Tridymite exhibits sharp boundaries with the dark, chondritic matrix and outlines suggesting crystal faces. It is intensely fractured and shocked. Although Fs indicates L affinities, δO^{18} (5.71) and δO^{17} (3.70) suggest H parentage.

Conclusions. Kendleton is a fragmental breccia that may have resided in a regolith, as indicated by the light-dark structure and presence of shock-blackened and a melt rock clast. Residence time in a regolith was short, as indicated by the absence of detectable solar wind gases and matrix heterogeneity on a thin section scale (suggesting poor mixing and low maturity). Although all materials except the tridymite-low-Ca pyroxene clast are of L-group composition, compositional variabilities between clasts and presence of type 3 inclusions indicate heterogeneities across the source regions on the parent body. Genesis and source of the tridymite-low-Ca pyroxene clast are uncertain.

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TRACE ELEMENTS IN HIGH-TEMPERATURE INCLUSIONS FROM MURCHISON

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Refractory inclusions in Murchison differ from those in Allende in being more hibonite-rich (Macdougall, 1981; MacPherson *et al.*, 1983) and, in some cases, in containing corundum (MacPherson *et al.*, 1984). This suggests that the former have higher nebular equilibration temperatures, also supported by these features of the former: absence of group I REE patterns, high frequency of patterns in which refractory REE are enriched relative to volatile REE and sub-chondritic Ir/Os and Ru/Re (Ekambaram *et al.*, 1984). We report trace element data for 7 more inclusions from Murchison, some of which are splits of those in MacPherson *et al.* (1984).

BBT-10 is a turquoise inclusion, thus probably hibonite-bearing. Relative to C1 chondrites, the Lu/Sm, Ho/Sm, Dy/Sm and Tb/Sm ratios are 10.4, < 3.0, 3.0 and 2.6, respectively. These fractionations among the most refractory REE, enrichments of these elements relative to Tm and

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light REE, and negative Eu and Yb anomalies are traits required of the condensate component postulated to have been lost prior to condensation of group II REE patterns (Ekambaram *et al.*, 1984; Boynton *et al.*, 1980; Palme *et al.*, 1982). As this ultrarefractory REE pattern has a lower Cl-normalized Lu/Tb ratio, 4.0, than SH-2 (Ekambaram *et al.*, 1984) and a higher one than that in Boynton *et al.* (1980), it is intermediate in refractoriness between them. This part of the REE pattern indicates the presence of a lithophile component with a much higher nebular equilibration temperature than that in Allende coarse-grained inclusions, most of which have group I patterns indicating low enough condensation temperatures that all REE condensed. As in SH-2, however, the relatively low Tb/Sm ratio indicates the presence of a second REE component in BBT-10, containing relatively volatile REE. Ir/Re and Ru/Re ratios are subchondritic, indicating that the siderophile component also has a higher equilibration temperature than in most Allende inclusions. SH-5 is a hibonite-spinel inclusion whose texture suggests vapor-solid condensation (MacPherson *et al.*, 1984). Its Cl-normalized Lu/Sm, Ho/Sm, Dy/Sm, Tb/Sm and Tm/Sm ratios of 14.1, < 3.0, 2.4, 1.8 and < 0.9, respectively, indicate the presence of an ultrarefractory REE component more refractory than that of SH-2 and addition of a slightly larger amount of volatile REE. Like other ultrarefractory inclusions. SH-5 has a large negative Yb anomaly but, unlike the former, a large positive Eu anomaly which, because of the volatility of Eu, would not be expected here unless Eu were added with the other volatile REE. Ir/Re and Ru/Re ratios are sub-chondritic in SH-5, as in BBT-10.

BB-9 is a hibonite-spinel spherule with minor melilite and perovskite (MacPherson *et al.*, 1984). Enrichments relative to Cl's are ~ 50 for light REE, 14 and < 1.8 for Eu and Yb, respectively, 214, 33, < 4.3 and < 1.7 for Tb, Dy, Ho and Lu, respectively, and 282 for Tm. Thus, it has a group II pattern but differs from all those reported so far in having much higher enrichments for Tb and Tm than for light REE. This could be the result of REE condensation into BB-9 at a higher temperature than for most group II inclusions. Refractory siderophiles are enriched by factors of 5 to 17 and Ir and Ru are again depleted relative to Re compared to Cl's. GR-1, a corundum-hibonite inclusion (MacPherson *et al.*, 1984), appears to have a group II REE pattern but the sample taken for INAA was so small that this is uncertain.

BLUB-1, an altered hibonite-spinel inclusion (MacPherson *et al.*, 1984), and MUM-4, a melilite-rich inclusion (MacPherson *et al.*, 1984), have group III patterns. The former has near-chondritic Ir/Os and Ru/Re; the latter is depleted in Ir and Ru relative to Os and Re compared to Cl's. OC-12, a forsterite-rich inclusion (MacPherson *et al.*, 1984), is uniformly enriched in most REE by a factor of 4 to 5 relative to Cl's except for positive Eu and Yb anomalies. Relatively low enrichment factors may be due to dilution of refractories by forsterite.

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[53]Mn IN MAIN FRAGMENTS OF THE NORTON COUNTY METEORITE

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The Norton County aubrite, which fell in 1948, was the largest stony meteorite known [preatm. mass ~ 3600 kg (Bhandari *et al.*, 1980)] until the fall of the Jilin chondrite [preatm. mass ≥ 4000 kg (Honda *et al.*, 1980)] in 1976. For the study of cosmic ray interaction effects it is valuable because, in contrast to Jilin, it was subjected to a very long and presumable one stage irradiation history (Herzog *et al.*, 1977). As coring of the friable main fragment of the achondrite (mass ~ 1070 kg) might result in severely damaging the specimen, only surface samples were taken. Of the McKinley fragment also interior samples were available.

We have measured cosmogenic [53]Mn ($T_{1/2} = 3.8 \times 10^6$ a) in 10 Norton County samples. Five of them were taken from main fragment locations where cosmic ray tracks have been determined previously (Bhandari *et al.*, 1980). The abundance of iron, the main target element