LEA CO. 002: A SECOND KAKANGARI-TYPE CHONDRITE. M. Prinz[1]: N. Chatterjee[1,2]; M.K. Weisberg[1,2], R.N. Clayton[3] and T.K. Mayeda[3]. (1) Dept. Mineral Sci., Amer. Museum Nat. Hist., New York, NY 10024. (2) Dept. Geology, Brooklyn College (CUNY), Brooklyn, NY 11210 (3) Enrico Fermi Inst., Univ. Chicago, Chicago, IL 60637

Kakangari is an unequilibrated (type 3.5) chondrite with mineralogical and chemical characteristics that are unique [1]. Chondrules (30 vol.%) and matrix (70%) are mineralogically near-identical in composition, which is also unique [2]. Chemically, Kakangari has some affinities with carbonaceous and ordinary chondrites, but differs from both [3]. Although highly reduced (mg #=96-98), close to that of enstatite chondrites, its planetary-type noble gases are closer to ordinary chondrite values [4]. It does not contain the unusual mineralogy of enstatite chondrites. Oxygen isotopic data for the Kakangari chondrules, matrix and whole rock [1] indicate it is indeed different from all C, O, and E chondrites (Fig. 1). The chondrules have isotopic compositions similar to those of the enstatite meteorites, and the matrix is unique.

Lea Co. 002 was described by Zolensky et al. [5] as an ungrouped (unique?) type 3 chondrite which is highly reduced (mg #=96-98), with mineralogic similarities to Kakangari and the chondritic clasts in the Cumberland Falls aubrite. The meteorite is intensely weathered (especially the matrix), and small in size (11g). The whole rock oxygen isotopic composition of Lea Co. 002 is relatively near that for Kakangari (Fig. 1), and lies on an apparent mixing line through the enstatite chondrites, including aubrites (EC-AUB), silicates in IAB irons, and the winonaites Winona, Pontlyfni, Mt. Morris and Acapulco. Several other unusual meteorites fall near this line, including Lodran, Sombrerete, and even MAC88177-a meteorite of uncertain affinity [6]. Some of these meteorites may be interlopers and may only accidentally fall near the line. Even the chondritic inclusions in Cumberland Falls are not very far from an extrapolation of the apparent mixing line across the terrestrial fractionation line.

One purpose of this study was to obtain separated chondrules from Lea Co. 002, characterize them mineralogically and petrographically, determine their oxygen isotopic compositions, and compare them to Kakangari chondrules. Additionally, further petrologic study of Lea Co. 002 was carried out, including a search for CAI's, so that a more definitive characterization of this meteorite could be made.

We were able to separate 3 chondrules from a chip of Lea Co. 002 obtained from the Smithsonian Institution. Two of these chondrules have porphyritic olivine-pyroxene (POP) textures, and one has a barred olivine [BO] texture. POP are, by far, the most common type in Lea Co. 002, and BO are rare. Their mineralogy and bulk compositions were compared with a suite of 8 other chondrules, and found to be comparable. Their oxygen isotopic compositions are given in Table 1 and shown in Fig. 1, compared with Kakangari data. All three chondrules fall along the same trend line as Kakangari and the apparent mixing line described above. The POP chondrules are more ^{16}O-enriched than the comparable Kakangari chondrules, and the rare BO chondrule is much more ^{16}O-enriched. The bulk of the chondrules must be near the POP chondrules. A modal analysis of Lea Co. 002 [5] indicated 67 vol.% chondrules (19% chondrules, 48% lithic fragments-which we interpret as chondrule fragments) and 33% matrix.

The matrix of Lea Co. 002 is heavily weathered and it is not possible to measure the oxygen isotopic composition directly. However, assuming the POP data represent most of the chondrules, and knowing the whole rock composition and the chondrule/matrix ratio, it is possible to estimate the composition of the matrix (assuming it falls along the trend line).

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This estimated matrix is very close in isotopic composition to that of the Kakangari matrix. Thus, the measured oxygen isotopic data of Lea Co. 002 are similar to those from Kakangari and these date lend strong support to the correlation of these two meteorites as part of the same group.

Petrologically, there are some problems in this correlation, some of which were cited earlier [5]. The chondrule/matrix ratio of Kakangari is 30/70, whereas that for Lea Co. 002 is 68/33. Variations in this ratio are reasonably narrow for most of the grouped chondrites, but sometimes there are large variations. For example, Renazzo has a chondrule/matrix ratio of 70/30, whereas Al Rais has a ratio of 30/70. A modal analysis of the minerals present in Lea Co. 002 resulted in similar values to those of Zolensky et al. [5] indicating a considerably higher olivine/pyroxene ratio in Lea Co. 002. A metal-sulfide-free mode of the silicates in Lea Co. 002 shows 40% olivine, 46% clinoenstatite and 4% clinopyroxene; Kakangari has 20% olivine, 70% clinoenstatite and 5% clinopyroxene. However, these data are mainly on chondrules, since the matrix is so heavily weathered, and the differences may not be significant. Petrologically, most of the data lend support to the correlation.

CAI's were found in Kakangari [1], and a search for them in Lea Co. 002 was successful. They are generally 50-500μm. Some are amoeboid olivine aggregates, and some are compact type B inclusions, with forsterite, fassaite, and perovskite; others are forsterite-anorthite, forsterite-fassaite, and anorthite-fassaite aggregates. The CAI's in Lea Co. 002 appear to differ from the spinel-pyroxene aggregates found in Kakangari [1], but the sizes of the inclusions are similar.

Thus, there are some minor petrologic and chemical problems in the correlation of Lea Co. 002 with Kakangari, but the major petrologic similarities and the oxygen isotopic data strongly support it. The small size and weathered nature of Lea Co. 002 adds additional problems.

References: [1] Prinz, M. et al. (1989) LPSC XX, 870-871. [2] Brearley, A. (1989) GCA 53,2395-2411. [3] Davis, A.M. et al. (1977) Nature 265, 230-232. [4] Srinivasan, B. and Anders, E. (1977) Meteoritics 12, 417-424. [5] Zolensky, M. et al. (1989) Meteoritics 24, 227-232. [6] Prinz, M. et al. (1991) this volume.

Tabel 1. Oxygen isotopic compositions in Lea Co. 002

		S18O	S17O
C1	BO	-0.43	-4.06
C2	POP	4.20	1.37
C3	POP	3.71	0.80
WR	WR	2.81	-0.21

WR=whole rock from [5].
C1,C2,C3 are chondrules.

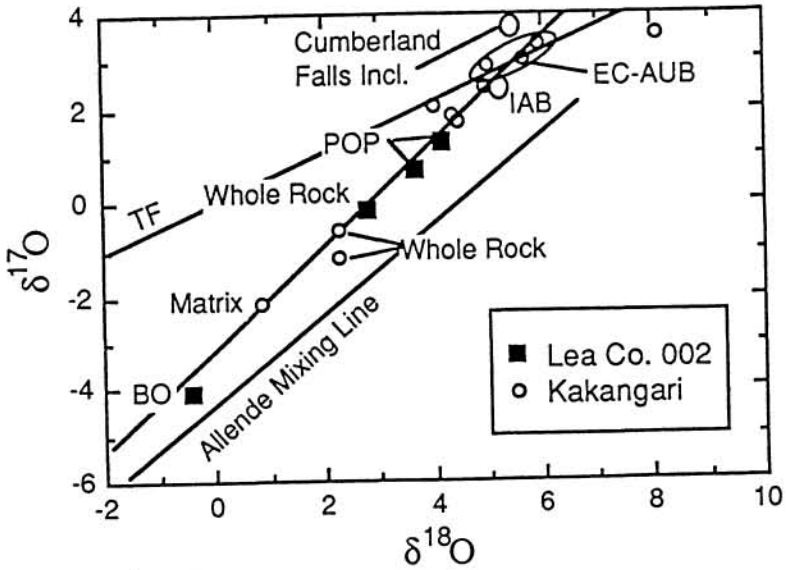

Fig. 1 Oxygen isotopic compositions of Lea Co. 002 whole rock and chondrules, compared with Kakangari and other meteorites.