Os, Ir, Ru, Re are in the Ni-rich metal with an increase of Os, Ir at the two metal interfaces.

Existing models of calculation (2, 3) to estimate the cooling rates are not valid for Vigarano. New results suggest that kamacite and taenite were in equilibrium near 500 °C. The taenite of 33% Ni is in equilibrium with kamacite at 500 °C. This grain does not show "M-profile." This could indicate either (1) fast cooling to 500 °C and then a period of growth or (2) fast cooling to low temperatures followed by reheating to 500 °C. In the first case, it would take about 10^6 years to grow 6 μm of kamacite if the Ni-diffusion coefficient in taenite controlled the process. In the second case, it would take about 10^4 years upon reheating to 500 °C assuming that the Ni-diffusion coefficient in kamacite controlled the process. The kamacite (4.9% Ni) in equilibrium with taenite indicates a lower equilibrium temperature <400 °C which would require 44% Ni in taenite. Therefore, measurements of phase equilibria in Fe, Ni, P, Ir, Ru, Re, Os alloys at 400–800 °C will be performed because their presence (4, 5) may complicate the system. OsRu exsolutions were probably formed *in situ* during this long stage at 500 °C. In contrast, scheelite and molybdenite with high Re-contents (4.76% and 1.36% respectively) could have preceded the incorporation in the CAI. The transformation times between 10^4 and 10^6 years are a reasonable first approximation. References: (1) Caillet C., MacPherson G. J. and El Goresy A. (1988) *Lunar Planet. Sci. Conf.* **19th,** 156–157. (2) Goldstein J. I. and Short J. M. (1967) *GCA* **31,** 1733–1770. (3) Wasson J. T. (1971) *Meteoritics* **6,** 139–147. (4) Romig A. D., Jr. and Goldstein J. I. (1980) *Met. Trans.* **11,** 1151–1159. (5) Dean D. C. and Goldstein J. I. (1986) *Met. Trans.* **17,** 1131–1138.

Geochemical Anomaly Across the Ordovician-Silurian (O-S) Boundary, Yichang, China, and Their Implications. C. F. Chai,[1] J. G. Ma,[1] P. Kong,[1] Y. Q. Zhou,[1] S. L. Ma[1] and X. F. Wang[2]. [1]Institute of High Energy Physics, Academia Sinica, P. O. Box 2732, Beijing, China. [2]Yichang Institute of Geological Sciences, P. O. Box 275, Yichang, China.

We studied elemental abundance variations across an O-S boundary (440 Ma ago) at Fengxiang, Yichang, Eastern Yangtze Gorges, China, where the paleontological work has been carefully done for many years, to examine whether the Ir anomaly similar to that at the Cretaceous-Tertiary boundary is present.

The Fengxiang O-S section is well exposed and yields abundant graptolites, comprising a complete graptolite succession from the latest Ordovician (Wufengian) to the earliest Silurian (early Longmaxian).

We determined the contents of Ir and 40 other elements across the O-S section by radiochemical and instrumental neutron activation. The Ir contents from 0.05 ppb at the late Ordovician increase to 0.64 ppb just at the O-S boundary, then decline to about 0.10 ppb at the upper Longmaxi Fm. The evident Ir anomaly is different from that across the Dob's Linn section reported by Wilde *et al.* (1986). The reason may be a rarity of fossils in the Dob's Linn sequence, which makes it difficult to define the exact O-S boundary.

Wilde *et al.* (1986) indicated that correlation of Ir with other elements, except for Cr, was not found to be significant. Our results do not agree with theirs. Ir of the Fengxiang section exhibits positive correlation with the siderophile elements (Au, Ni and Co), as well as with the chalcophile elements (As and Sb), besides Cr. The contents of Au, Ni, Co, As and Sb at the O-S boundary are (ppm): 0.0166, 527, 20.1, 54.5 and 27.2, respectively. Our results do not support the conclusion that the high Ir background abundances may be from erosional contribution from chromium-bearing minerals.

The geochemical anomaly, supported by carbon isotope excursion and paleo magnetic evidence, of the O-S section implies a sudden event happened at the end of the Ordovician.

Finally, it should be emphasized that the O-S boundary should be placed between the *Hirnamtia-Kinnella* Zone and *G. persculptus* Zone, where the geochemical anomaly, isotope excursion and paleomagnetic variation occur, instead of the base of the *P. acuminatus.*

This work is supported by National Natural Science Foundation of China (NSFC). Reference: Wilde P. *et al.* (1986) *Science* **233,** 339.

Chemical Speciation Study of Anomalous Iridium from K-T Boundary. C. F. Chai and P. Kong. Institute of High Energy Physics, Academia Sinica, P. O. Box 2732, Beijing, China.

By means of a newly developed chemical dissociation procedure, we studied the distribution patterns of Ir, Au, Ni, Co, Fe, As and Sb in the Cretaceous-Tertiary (K-T) boundary samples taken from the Stevns Klint, Denmark, and Montana, USA, the Ningqiang chondrite (CV3) and the Baoxian chondrite (LL4), and ultrabasic rock from the Saltohai, Xinjiang, China, in order to reveal the origin of excess iridium. The samples were chemically divided into 6 phases, *i.e.,* carbonate, Fe-Ni metal, sulfide, oxide, silicate and insoluble residue in strong HF medium. The weight fractions (%) of each phase in the K-T boundary is 25.7 (carbonate), 9.1 (Fe-Ni), 22.5 (sulfide), 12.2 (oxide), 25.7 (silicate) and 4.7 (HF-insoluble residue), while its Ir relative abundance (%) is 4.3, 25.0, 0, 12.3, 0 and 58.6, respectively. It implies that although the residue phase only constitutes less than 5% of its parent sample in weight, it contains over 50% Ir of the total, with an enrichment factor of above 40 relative to the source material.

The Ir speciation results of the K-T boundaries including marine and continent sediments are similar to those of the Ningqiang chondrite, but show large discrepancy with those of the ultrabasic rock, which seems to favour the extraterrestrial origin of the anomalous iridium.

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The Thermoluminescence Properties of Mn-Plagioclase Mixtures with Implications for Meteorites. Clark Chickering,[2] J. David Batchelor,[2] Derek W. G. Sears[1] and R. Kyle Guimon.[2] Cosmochemistry Group, Department of Chemistry and Biochemistry, Univ. Arkansas, Fayetteville, AR 72701 USA. [2]Physical Science Department, Missouri Valley College, Marshall, MO 65340 USA.

The thermoluminescence (TL) properties of meteorites have provided unique insights into several aspects of their history, most notably metamorphism and shock (1). Through a number of laboratory experiments and measurements on natural samples, it has been shown that TL sensitivity reflects the amounts of feldspar, and the peak shape (peak temperature and width) relate to the relative amounts of high and low feldspar (2). However, certain properties remain poorly understood; for example, TL sensitivity decreases strongly along the plagioclase series as Ca increases (3), and the peak temperature of the high form seems to vary in a poorly understood fashion (4). Important in our attempts to explain some of these properties are data of Geake *et al.* (5), who observed that plagioclase showed a 17-fold increase in blue/green cathodoluminescence (CL) when annealed with $MnSO_4$ for 30 minutes at 1050 °C. Based on these data and arguments involving the ligand field of Mn in $CaSiO_3$ and feldspar, Geake *et al.* argued that Mn was the activator for CL in lunar and terrestrial plagioclase. CL and TL are closely related phenomena, and presumably this implies that Mn is an important activator for TL in meteoritic feldspar. We have therefore repeated the Geake *et al.* experiments, extending the annealing to much longer times, in an attempt to confirm their finding.

Samples of bytownite and mixtures of bytownite and $MnSO_4$ (2 wt.%) were annealed at 1050 °C for 30 minutes and 50 hours and the induced TL measured. We found that after annealing for 30 minutes the TL sensitivity decreased by about 50%. The peak temperature also increased from 80 to 140 °C. In contrast, after annealing for 50 hours we did find a significant increase in TL sensitivity, but the increase was shown by both the bytownite and the bytownite-$MnSO_4$ mixture and is clearly associated with the thermal treatment and not any doping effect on the part of the Mn; in fact, the mixture showed a much smaller increase than the pure bytownite. We also observed very large increases in peak temperatures similar to those previously reported by Hartmetz and Sears (4). These data have several implications for CL and TL studies of meteorites. For instance, thermal treatments in a closed system can cause increases in TL sensitivity, as well as peak shape changes, in certain cases, without the need to invoke chemical changes. Also, the often-reported association between Mn and feldspar CL may not be causative. (Support: NASA NAG 9-81.) References: (1) Sears and Hasan (1986) *LPI Tech. Rpt.* **86-1,** 100. (2) Guimon *et al.* (1985) *GCA* **49,** 1515. (3) Hasan *et al.* (1986) *J. Lumin.* **34,** 327. (4) Hartmetz and Sears (1987) *LPS* **18,** 395. (5) Geake *et al.* (1971) *Proc. Lun. Sci. Conf.* **2nd,** 2265.

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