MAGNESIOFERRITE FROM A NONMARINE K-T BOUNDARY CLAY IN WYOMING; B.F. Bohor and E. E. Foord, U. S. Geological Survey, Box 25046, Denver, CO 80225

Previous studies (1-3) of magnesioferrite (spinel) in Cretaceous- Tertiary (K-T) boundary clays have been from sites in marine rocks. Because of the nature of marine deposition (large water column and bioturbation), sedimentary mixing is common and a clear demarcation of short-lived depositional events may be obscured. This is apparent in the case of the K-T boundary event, where marine sections show an intimate mixture of shocked minerals and spherules in a single layer with an iridium anomaly. In contrast, nonmarine sections in the Western Interior of North America (4), such as the Dogie Creek site in Wyoming (5), show two distinct layers in the K-T boundary clay interval. The basal kaolinitic layer contains spherules, but no shocked minerals, magnesioferrite, or significant iridium (6). A thin smectitic upper layer contains shocked minerals and a large iridium anomaly. This is the actual impact ejecta layer and it also contains magnesioferrite crystals, thus confirming the impact origin of the magnesioferrite by association and microstratigraphy. The basal kaolinitic layer contains no magnesioferrite and is postulated to be derived from ejecta of upper mantle rocks exposed by the impact at the crater floor (6).

Magnesioferrite crystals are very sparsely distributed in the impact ejecta layer at the Dogie Creek site. Most of the magnetic fraction consists of X-ray-amorphous iron silicate. Insufficient magnesioferrite was recovered for preparation of a microprobe mount, so the compositions of 7 crystals were determined with an energy-dispersive X-ray analyzer on an SEM. Twenty-three crystals of magnesioferrite from a K-T boundary clay in marine rocks at Caravaca, Spain, had previously been analyzed by both microprobe and SEM energy-dispersive (EDS) methods (3). Semiquantitative EDS values are derived from crystal surfaces in the SEM and could not be corrected by the quantitative microprobe values because a large proportion of the latter were derived from crystal interiors; we have observed that these magnesioferrite crystal are compositionally zoned. Figure 1 is a ternary plot of Fe_2O_3-Cr_2O_3-NiO from the EDS data of the Caravaca and Dogie Creek samples. The average iron content is about the same for magnesioferrites from both sites, but the average Ni content for Caravaca is twice that from Dogie Creek; the average Cr content for Caravaca is about 1/2 that from Dogie Creek. Figure 2 is a plot of the MgO vs. Al_2O_3 values from the same EDS data. Both the MgO (avg. = 4.26 wt. %) and Al_2O_3 (avg. = 2.61 wt. %) values for Dogie Creek material are lower than those for Caravaca (avg. = 5.06 wt. % MgO and 3.8 wt. % Al_2O_3).

Figure 3 is an SEM photo of a typical octahedral magnesioferrite crystal from the Dogie Creek site. Figure 4 is an SEM photo of a skeletal magnesioferrite crystal from the Caravaca site; no skeletal crystals were found at the Dogie Creek site.

These data support the hypothesis that the magnesioferrite crystals found in K-T boundary clays are impact derived and that their MgO and Al_2O_3 contents increase away from the probable impact crater site (inferred from shocked quartz grain sizes, 7), possibly because of initial preferential scavenging of Fe^{+2} relative to Mg, and Fe^{+3} relative to Al in the cloud of vaporized impact ejecta.

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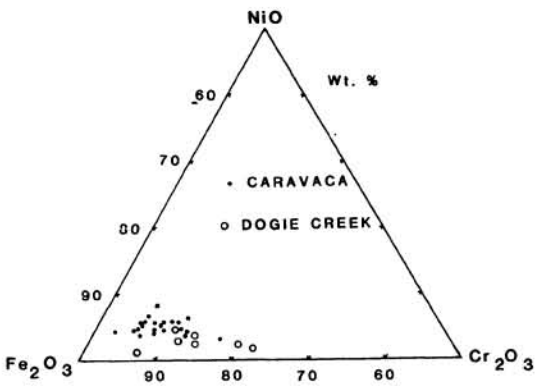

Fig. 1. Ternary plot of Fe_2O_3-Cr_2O_3-NiO contents of magnesioferrite from Caravaca, Spain, and Dogie Creek, Wyo.

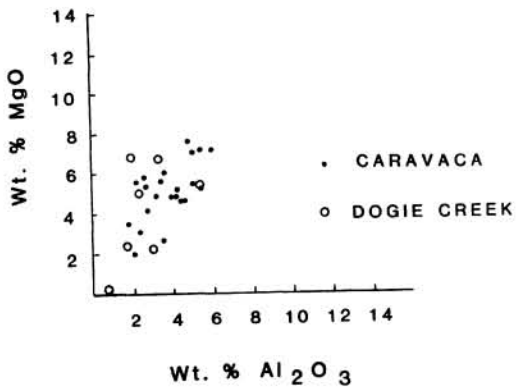

Fig. 2. Plot of MgO vs. Al_2O_3 for magnesioferrite from Caravaca, Spain, and Dogie Creek, Wyo.

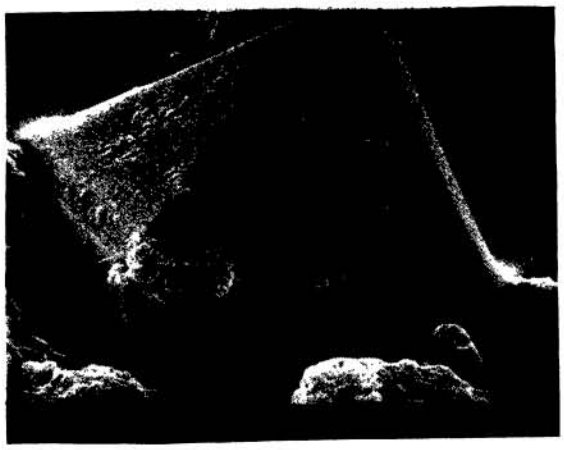

Fig. 3. SEM photo of octahedral crystal of magnesioferrite from Dogie Creek, Wyo. Scale bar = 4 micrometers.

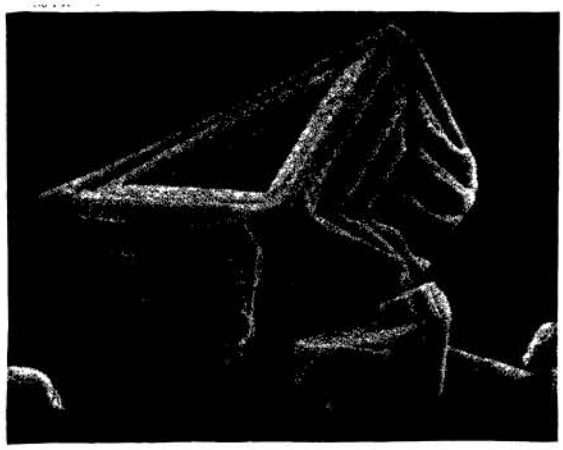

Fig. 4. SEM photo of skeletal crystal of magnesioferrite from Caravaca, Spain. Scale bar = 10 micrometers.

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