ZONATIONS IN SPINEL FROM METEORITE FUSION CRUSTS AND THEIR RELEVANCE TO IMPACT SPINEL FORMATION.

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Introduction: Ni-rich spinel present in K/T boundary clays [1,2] is a cosmic event marker, but its formation is still controversial [3-6]. K/T spinel is characterized by a high Ni^{2+} and Fe^{3+} content involving formation in an oxygen-rich environment [5-7]. Some of these crystals show a compositional zoning from core to rim, with a core depleted in Fe, Ni and Ti, and enriched in Cr, Al and Mg [8, 9]. Similar zonations have been reported in spinel from meteorite fusion crusts [5, 10], but these have never been studied in detail.

We report here SEM observations and EDS analyses of zoned spinel crystals from various meteorite fusion crusts (Orgueil, Murchison, Krymka, Bruderheim and Beni M'hira) and two K/T boundary sites (Bidart in France and Caravaca in Spain).

Results: Spinel from meteorite fusion crusts occurs mostly as small (0.5-1 µm), chemically homogeneous, dendritic crystals. Rare large euhedral crystals (up to 3 µm) with skeletal and well developed octahedral morphologies are observed, however. Some of them display a compositional zoning with a decrease in Cr and an increase in Fe and Ni toward the margin. The Cr-rich core also contains variable amounts of V, the abundance of which (up to 1.5 wt%) is positively correlated with the Cr content of the core. The highest V concentrations are observed in primary chromite grains present in both the fusion crust and the unmelted core of the meteorites.

Discussion: The compositional similarity between the Cr-rich spinel cores and the primary chromite grains suggests that spinel zonation originates from incomplete equilibration of primary spinel crystals at subliquidus temperatures. Incomplete equilibration results from the pulse heating experienced by the meteorite during atmospheric entry and is shown by the occurrence in the fusion crust of i) dendritic crystals; and ii) relic chromite grains. A similar origin can be invoked for the compositional zonations observed in impact spinel from the K/T boundary. If so, this excludes a formation by condensation in the impact plume.

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