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The EH Earth and the Chronology of its Formation

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Stable isotope considerations and, among them, prominently, oxygen and nitrogen data lead to the conclusion that the best model constituent for the very reduced material which constituted most of the Earth has to be found in the EH enstatite chondrite chemistry (Javoy, 1995, 1998, 1999). Given the characteristics of that chemistry, far removed in certain respects from conventional ideas, one has to describe precisely the mechanisms which make that bulk composition compatible with the observed characteristics of the terrestrial envelopes: these include a very energetic event (most likely the Great Impact responsible for the Moon formation) providing the temperature conditions for the extraction of large amounts of silica from the mantle by the sinking Fe-Ni metal. In such a model the definitive core formation is quasi synchronous with the Great Impact. It leads to a two-layers mantle with a lower mantle enriched in silica and depleted in magnesium, whereas the Primary Upper Mantle (before crust differentiation) and the Core compositions resemble those of conventional models. The depletion of the present Upper Mantle in Al, Ca and other elements relative to its primary composition leads to the idea of a transition zone steadily enriched in these elements by subduction, with the upper mantle-transition zone-crust system equivalent to the primary upper mantle and exchange between upper and lower mantle limited to the very late history of the Earth. The detailed composition of the main envelopes can be found in Javoy (1999).

Among the salient features the fact that the 650 km discontinuity is both a phase and chemistry discontinuity, that the transition zone is significantly enriched in Al, Ca, Na and K, and that the D" zone appears as the result of a demixion phenomenon of the silica-rich Fe-Ni liquid during its migration to the Core.

This model has many implications in terms of mechanisms, chemistry and chronology, some of which having already been verified such as the extreme ^{15}N depletion of some diamonds, found after the first publication of this model, (Cartigny et al., 1997) the large solubility of silicon in liquid iron under Redox conditions similar to those proposed by the model. Recent results on extinct radioactivity (Lee & Halliday 2000), can be used to describe very simply the chronology of the formation of the EH Earth. Counting the years "after Allende inclusions" that is 4568 million years before present, the first step towards the formation of the Earth to occur is a strongly reducing, Fe and Silicon-bearing, irradiation of the inner solar system, at 12±2 million years "after Allende", then, after on-going Wetherill type accretion in that zone, the Great Impact at 38±5 million years, leading to the formation of the Moon and the present Core, then a period of very strong CI- type meteorite bombardment, continuing up to 700 more million years but with the bulk of it between 45 and 200 million years "after Allende".

Javoy M, *Geo. Res. Lett.*, **22**, 2219-2222, (1995).
Javoy M, *Chem. Geol.*, **147**, 11-25, (1998).
Javoy M, *C. R. Acad. Sci*, **329**, 537-555, (1999).
Cartigny P, Boyd, SR, Harris JW & Javoy M, *Terra Nova*, **9**, 175-179, (1997).
Lee DC & Halliday AN, *Science*, **in press**