HISTORY AND EVOLUTION OF METAL FROM STONY-IRON METEORITES ACCORDING TO TUNGSTEN ISOTOPES AND RELATIONSHIP WITH EUCRITES.
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Introduction: Using tungsten isotopes, the iron counterpart to the source of eucrites at the time of its differentiation has not been found yet among known classes of iron meteorites [1]. Oxygen isotopes indicate that mesosiderites and pallasites may have formed in the same region of the solar system as the basaltic achondrites, perhaps on a common parent body [2]. Therefore, we have measured tungsten isotopes in the metal phase of 8 mesosiderites and 5 pallasites by negative thermal ionisation mass spectrometry (NTIMS) to determine whether they represent the metal phase complementary to eucrites. The Hf-W system involves two elements of strongly different geochemical properties: Hf is lithophile whereas W is moderately siderophile. This system is well suited to study the formation of stony-irons and the metal-silicates mixing.

Results: Tungsten isotopic data are quoted in epsilon units (relative deviation in parts per 10^4). All stony-iron metal phases are depleted in radiogenic tungsten relative to a terrestrial standard and there is no clear trend between the petrological type of mesosiderites and the isotopic composition. Mesosiderites present a spread of ratios ranging from the same signature as iron meteorites to less ^{182}W-depleted. Concerning the pallasites, isotopic compositions vary between -4.2 and –2.8 epsilon, in the range of iron meteorites, except Glorieta Mountain which cooled very slowly. Different meteorites as well as several samples of the same meteorite display variations in the W isotopic compositions. An isotopic zonation exists in a pallasite sample too. This heterogeneity can originate in different processes described hereafter.

Discussion: As all metal phases are tungsten rich in the absence of radiogenic W, the early signature of the meteorite is less sensitive to late events, even if intense secondary events have affected mesosiderites [3-5].

The Hf concentration in metal is extremely low because Hf is lithophile. But a Hf carrier phase like phosphates may be present as inclusions. Considering the low Hf concentration measured in our samples, the radioactive decay of ^{182}Hf may be responsible for an isotopic variation of less than 1 epsilon since the metal-silicates fractionation and the closure of the system. A second hypothesis is that the metal comes from different sources formed at different times. A complex formation scenario involving an internal *and* an external origin for the metal could explain the heterogeneity in mesosiderites and the fact that some samples present the same isotopic signature than the source of eucrites. But a most plausible explanation is diffusion, isotopic exchange and partial reequilibration. The chemical homogeneisation induces a tungsten diffusion from metal to silicates, whereas the faster isotopic exchange transfers ^{182}W from the silicates to the metal.

As a summary, several causes are conceivable to explain the tungsten isotopic heterogeneity in metal phases of stony-iron meteorites: the presence of Hf as inclusions in the metal, mixing of metal from different reservoirs, and mostly radiogenic tungsten diffusion by isotopic exchange.

References: [1] Quitté G. et al. (2000) *EPSL, 184,* 63-74. [2] Clayton R.N. and Mayeda T.K. (1978) *EPSL, 40,* 168-174. [3] Bogard D.D. et al. (1990) *GCA, 54,* 2549-2564. [4] Delaney J.S. et al. (1981) *LPSC XII,* 1315-1342. [5] Stewart B.W. et al. (1994) *GCA, 58,* 3487-3509.