THE COMPLEX HISTORY OF TISSINT INFERRED FROM DIFFERENT TYPES OF MELT INCLUSIONS AND ISOTOPIC SYSTEMS.

L. Ferrière[1], F. Brandstätter[1], D. Topa[1], T. Schulz[2,3,4], I. P. Baziotis[5], C. Münker[3,4], and C. Koeberl[1,2]. [1]Natural History Museum, Burgring 7, A-1010 Vienna, Austria. E-mail: ludovic.ferriere@univie.ac.at. [2]Dept. of Lithospheric Research, Univ. Vienna, A-1090 Vienna, Austria. [3]Institute of Geology and Mineralogy, Univ. Cologne, 53225 Cologne, Germany. [4]Steinmann Institute, Univ. Bonn, 53115 Bonn, Germany. [5]Dept. of Mineralogy, Petrology and Economic Geology, Aristotle Univ. of Thessaloniki, 54124, Greece.

Introduction: The Tissint meteorite fell on the 18th of July 2011 in Morocco and was quickly recovered, allowing to investigate a new unaltered sample from Mars. It is a depleted picritic shergottite with very magnesian olivines and abundant impact metamorphism features, including many black glassy melt pockets (up to cm in size) and melt veins and a large variety of high-pressure minerals and phases [1, 2]. The NHM Vienna acquired a large (909 g) stone and several smaller samples of Tissint.

Here we discuss the complex history of the Tissint meteorite, from its crystallization until its ejection as recorded by the different types of melt occurrences (primary inclusions in olivines and impact related) using optical and electron microscopy techniques (on five thin sections), in combination with isotope geochemistry analyses on a whole-rock (bulk) separate of about 100 mg of a homogenized 2 g fragment of Tissint.

Results and Discussion: Olivines in Tissint, as in most Martian meteorites, contain melt inclusions (e.g., [3]) a few micrometers to more than 200 µm in size. Our microprobe investigations show that they are of different types, some being almost totally glassy (Si-rich), while others are partially crystallized, mainly consisting of pyroxene and plagioclase crystals, as well as Ni-bearing Fe-sulphides and oxides (chromites). Their composition allows placing constraints on the crystallization history of the residual melts (including chemical compositions and cooling rates). Then, after crystallization, the rock was affected by metamorphism, mainly impact metamorphism, as described in detail by [2]. We assume that most of the shock features in Tissint were generated during the impact that was responsible for its ejection from Mars. Importantly, we do not favor any involvement of phases produced by Martian secondary processes in the formation of the black glassy melt pockets as claimed by [1]; this view is now also confirmed by Barrat et al. [4], who have shown that the impact melts in Tissint have the exact same trace element characteristics as the host rock. Thus, our isotopic data are considered to be representative of the pristine, unweathered, rock. Isotope ratios back calculated to an age of 616 Ma [5] are: ^{176}Hf/^{177}Hf = 0.284077(7) (ε^{176}Hf = +59.5) and ^{143}Nd/^{144}Nd = 0.513935(13) (ε^{143}Nd = +40.9). These results agree well with previous analyses [5] and confirm that Tissint was derived from a highly depleted Martian mantle source.

References: [1] Chennaoui Aoudjehane H. et al. 2012. *Science* 338:785–788. [2] Baziotis I. P. et al. 2013. *Nature Comm.* 4:1404. [3] Sonzogni Y. and Treiman A. H. 2013. Abstract #1049. 44th Lunar & Planetary Science Conference. [4] Barrat J. A. et al. 2013. *GCA* (in review). [5] Grosshans T. E. et al. 2013. Abstract #2872. 44th Lunar & Planetary Science Conference.