NEW CONSTRAINTS ON THE WATER BUDGET IN THE MARTIAN BRECCIA METEORITE NWA 7533.

L. Remusat[1], B. Zanda[1], P. Beck[2], J.-P. Lorand[3], S. Pont[1], H. Leroux[4] and R. Hewins[1]. [1]IMPMC, Sorbonne Univ., UMR CNRS 7590, UPMC, IRD, MNHN, Paris, France. E-mail: remusat@mnhn.fr. [2]IPAG, UMR CNRS 5274, UJF, Grenoble, France. [3]LPG, UMR CNRS 6112, Univ. Nantes, France. [4]UMET, UMR CNRS 8207, Univ. Lille 1, Villeneuve d'Ascq, France.

Introduction: Meteorite NWA 7533 is a polymict Martian breccia likely originating from a regolith on the surface of Mars [1]. Its petrology reveals a complex history with several shock events and impact melting [2]. It is paired with NWA 7034, which is water-rich compared to other Martian meteorites including the SNC [3]. In addition, NWA 7034 and 7533 have been shown to originate from rocks that had interacted with the atmosphere and hydrosphere of Mars since the Noachian [4, 5]. It therefore offers a unique opportunity to assess the evolution of water on Mars [2]. Several reports have been made on the water budget in NWA 7034 but the debate about the water reservoirs remains open [6, 7]. Here, we have investigated the water content and D/H ratio of several clast phases in NWA 7533 using the NanoSIMS 50 installed at MNHN.

Material and Methods: A doubly polished thin section (50 μm) was prepared from a 17g sample that was cut without any water or lubricant. The section was studied by SEM to identify small apatite, ilmenite and oxyhydroxyde grains (5 to 50 μm large) in the matrix and the melt rock. Water content was first measured through the OH^-/O^- ratio. H-isotopes were next monitored using a larger primary current. Each measurement was performed using a Cs^+ primary beam, rastered over areas of 5×5 μm^2. The beam blanking mode was used to reduce surface contamination (real sampling surface 3×3 μm^2).

Results and discussion: Oxyhydroxyde grains around pyrites exhibit a terrestrial H-isotopic signature and are therefore likely products of terrestrial weathering of Martian pyrites [8]. Water concentration in NWA7533 apatites is variable $560<[H_2O(ppm)]<3050$. This water is Martian as shown by D-enrichment, though with large variations: $250<\delta D(‰)<2230$. Surprisingly, ilmenite clast have between 2000 to 3600 ppm of D-rich water: $1370<\delta D(‰)<3130$. Considering modal abundances and water contents of the phases, we cannot explain the 6000ppm reported in NWA7034 [3].

During its 4.4 Ga of history [5], NWA7533 has witnessed the evolution of the water reservoirs at the surface of Mars. Apatites, moderately enriched in D, are believed to have been disturbed at 1.35 Ga [9]. The shock event may have induced some water remobilization explaining the large variability in both water content and D/H. Although no absolute age is available for the ilmenite grains, they represent late crystallizing minerals in monzonitic igneous clasts and therefore may be as old as apatites (4.4 Ga). Late fracturing and subsequent water alteration may also explain their large H_2O contents coupled with D-rich compositions.

References: [1] Humayun M. et al. 2013. *Nature* 503 :513-516. [2] Hewins R. H. et al. 2014. Abstract #1416. 45th LPSC. [3] Agee C. B. et al. 2013. *Science* 339 :780-785. [4] Cartwright J. A. et al. 2014. *EPSL* 400 :77–87. [5] Nemchin A. A. et al. 2014. *Nature Geoscience* 7 :638-642. [6] Liu Y. et al. 2014. Abstract #2368. 45th LPSC. [7] Muttik N. et al. 2014.*GRL*. 41 : 2014GL062533. [8] Lorand J.-P. et al. 2015. *MAPS* under review. [9] Bellucci et al. 2015. *EPSL* 410 :34–41.