**THE NEW SILICATE-BEARING IRON METEORITE NWA 6369 PAIRED TO NWA 5549.** S. N. Teplyakova[1], C. A. Lorenz[1], M. A. Ivanova[1], A. V. Korochantsev[1], S. E. Borisovsky [2], I. A. Franchi[3] and M. Humayun[4], [1]Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Moscow, Kosygina st.19, 119991 (elga.meteorite@gmail.com), [2]Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, Russian Academy of Sciences, IGEM RAS, [3]PSSRI, The Open University, Milton Keynes, MK7 6AA, UK,[4]National High Magnetic Field Laboratory and Department of Earth, Ocean & Atmospheric Science, Florida State University, Tallahassee, 1800 E. Paul Dirac Drive, FL 32310, USA.

**Introduction.** North West Africa 6369 is a recent iron meteorite find with silicate inclusions, most probably paired with NWA 5549. Here we report preliminary results on petrography, mineralogy and chemistry of the NWA 6369 meteorite based on a petrological and geochemical study of large surfaces of several samples. Polished sections of NWA 6369 from the meteorite collection of the Russian Academy of Sciences was studied by optical microscopy at the Vernadsky Institute. Mineral chemistry was determined by EPMA in IGEM RAS. Oxygen isotopic composition was measured at the Open University (UK). Bulk metal major and trace elements were determined by tracks in thick polished sections by LA-ICP-MS [1] at Florida State University.

**Results:** We examined two slices with a total area of 150 $cm^2$. NWA 6369 consists of FeNi-metal ~80 vol.% and silicate inclusions (SIs) ~20 vol.% (Fig.1).


Fig.1. Macroscopic image of etched polished slice of the NWA 6369 iron.

The FeNi-metal fraction of NWA 6369 consists of kamacite ~93 vol.% (Ni 6.5 wt.%, Co 0.46-0.54 wt.%, P 0.03-0.06 wt.%), troilite ~4 vol.%, graphite+schreibersite+plessite+taenite ~3 vol.%

Laser tracks (50 µm spot, scanned at 10 µm/s) were taken on five separated metal fragments, and a sixth, large metal piece was analyzed by rastering the beam over 865 µm x 717 µm area. Trace element abundances in kamacite are (ppm): Cu - 153 ± 15, Ga - 79 ± 3, Ge - 342 ± 13, As – 10.8 ± 0.6, Mo -7.2 ± 0.4, Ru – 5.75 ± 0.34, Rh – 1.27 ± 0.05, Pd – 2.8 ± 0.5, Sn - 5 ± 0.95, W – 0.92 ± 0.09, Re – 0.35 ± 0.04, Os – 4.7 ± 0.4, Ir – 3.9 ± 0.4, Pt – 6.44 ± 0.86, Au – 1.23 ± 0.07 (Fig. 2).

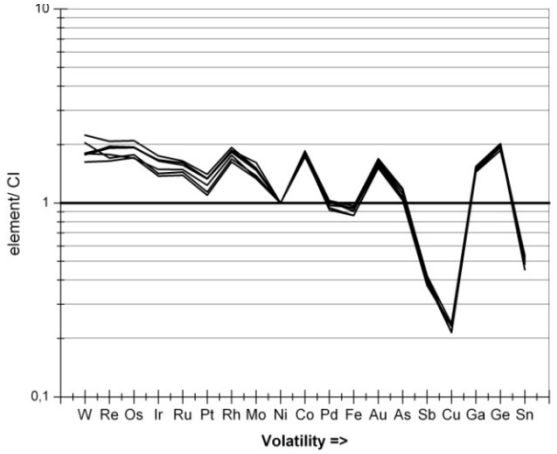


Fig. 2. Concentrations of siderophile element abundances in the NWA 6369 iron meteorites. Data are normalized to Ni and CI and ordered by volatility.

Metal consists of polygonal grains of kamacite, up to 1.5 cm in size with rare taenite lamellae. Neumann lines are abundant in kamacite. The taenite lamellae have M-shaped profiles. Plessite fields contain globules of taenite in kamacite. It could be determined as a rare "spheroidized plessite" (Fig. 3) according to Buchwald classification [2]. Schreibersite crystals (up to 500 µm in size) and euhedral graphite grains (up to 5-40 µm in size) occur between kamacite grains.

The fine-grained assemblage of troilite and graphite is associated with metal-SI boundaries. Swathing schreibersite surrounds the troilite and graphite mixture.

SIs have irregular fragmental shape and consist of olivine ($Fa_{4.9}$, Fe/Mn=7-12), pyroxene ($Fs_{7.2}Wo_{1.4}$, Fe/Mn=7-12), augite $Fs_{3.4}Wo_{45.1}$), plagioclase ($Ab_{80.7}An_{15.7}$), chromite (Cr/(Cr+Al)=97.3; MnO 2.67 wt%, $V_2O_3$ 0.69 wt%, ZnO 1.66 wt%,) and graphite. The modal composition of the SI silicate portion is (vol.%): Ol-18.7; Opx-24.3; Cpx-1.3; Pl-50.7; Gr-3 and of the metal portion (kamacite and taenite) is (vol.%): 2.

Oxygen isotopic composition of NWA 6369 is: $\delta^{17}O$ = 2.353 ‰, $\delta^{18}O$ = 5.388 ‰, $\Delta^{17}O$ = –0.448 ‰.

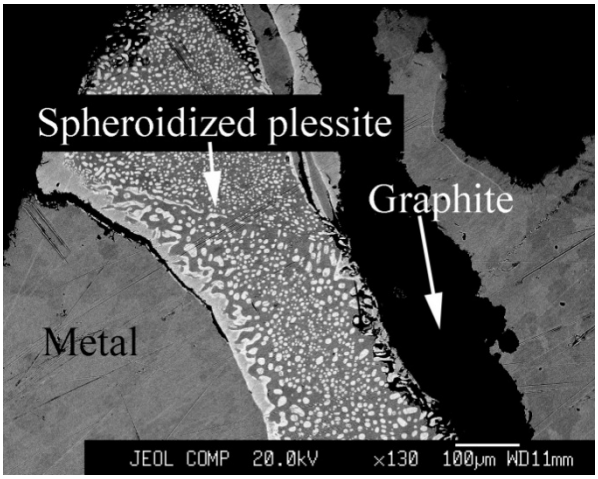


Fig. 3. BSE image of spheroidized plessite in NWA 6369

**Discussion:** Texture of the iron is anomalous. In general, it is granular and doesn't correspond to hexahedrite which contains grains or bands more than 3.3 mm in size. On macro scale we observe octahedrite characteristics of the texture - rare lamellae of taenite and spheroidized plessite following the widmanstätten direction. Spheroidized plessite formed as a result of dissolution of carbon in the metal from graphite as was proposed in [2]. Coarse-grained texture, M - shaped profile in taenite lamellae and Agrell's effect in kamasite indicate slow cooling rate below $450^0$C.

The texture of NWA 6369 is similar to that of Horse Creek, classified as hexahedrite with unique lamellae of nickel silicide formed by breakdown of Si-rich metal along planes of widmanstätten structure (111) [2]. These two meteorites possible represent a new type of the FeNi-metal texture. We propose that minor elements like Si in the Horse Creek metal and C in the NWA 6369 metal led to formation of the unique texture unknown for other irons that consist mainly of Fe-Ni-P. Despite the textural similarity, a genetic relation between Horse Creek and NWA 6369 are not observed from siderophile elements [3].

Based on mineralogy we designate this iron as a kamacite iron. We have analyzed trace element abundances in kamacite only because small fields of plessite and taenite were not captured by the tracks taken. However, since kamacite is the dominant metal phase in this meteorite, the composition reported here is likely to be close to the bulk composition. This average composition of the NWA metal belongs to the IAB iron group [4], consistent with classification of the paired NWA 5549 iron [5]. The elemental abundances of Co, Ga, Ge, As, W and Ir, are similar to those reported for NWA 5549 [5], while the abundances of Ni and Au are lower by 14% and 19%, respectively, probably due to under-representation of taenite in the LA-ICP-MS tracks. A mass-balance approach on Ni contents by LA-ICP-MS yields a fraction of kamacite of ~97%.

Kamacite is enriched in HSEs with non-chondritic siderophile element pattern (Fig. 2). The absence of W/Ir and Re/Os anomalies in metal is not consistent with a high carbon content in the metallic liquid [6]. To understand this result, we assume that carbon may have been sequestered with silicate inclusions.

Compositions of main minerals in SIs and their Fe/Mn ratio are similar to chondritic silicates and SIs from the IAB irons [7]. The SIs of NWA 6369 differ from those in IIE [8, 9] and IIICD [10] iron groups. The low Fa of olivine (4.9) and Fs of pyroxene (7.2) and a high content of graphite in SIs probably indicate a reduction process in history of silicates formation. The SIs contain an unusual chromite composition which is enriched in MnO and depleted in $Al_2O_3$. The oxygen isotopes composition of SIs in NWA 6369 is in the range of the IAB meteorites [11], which strengthens the link to IABs.

**References:** [1] Campbell, A.J. and Humayun, M. (1999) *Anal. Chem.* 71, 939-46. [2] Buchwald (1975) *Handbook of iron meteorites*. [3] Humayun (2010) *MAPS*, 45, abstract#5375. [4] Wasson J. T. and Kallemeyn G. W. (2002), *GCA*, 66, 2445-2473. [5] *Meteoritical Bulletin, no. 99, MAPS*, 46, in preparation (2011). [6] Chabot N.L. et al (2006) GCA, 70, 1322-1335 [7] Benedix G.K. et al. (2000) *Meteorit. & Planet Sci.* 35, 1127-1141. [8] Ruzicka A. et al. (1999) *GCA*, 63 2123-2143. [9] Kurat et al. (2007), *Meteorit. & Planet Sci.*, 42, 1441-1463. [10] McCoy T.J. et al (1993) *Meteorit. & Planet Sci.* 28, 552-560. [11] Clayton R.N. and Maeyda T.K. (1996), *GCA*, 60, 1999-2018.