NORTHWEST AFRICA 6485: PARTIALLY FRACTIONATED LL CHONDRITE MELT ROCK. C. A. Lorenz[1], N. N. Kononkova[1], I. A. Franchi[2], [1]Vernadsky Institute of geochemistry and analytical chemistry RAS, 119991, Kosygin St. 19, Moscow, Russia; c-lorenz@yandex.ru, [3]Planetary & Space Sciences, Open University, Milton Keynes, UK.

Introduction: The rocks formed by complete melting of chondrite materials are rare [1]. However, they record important information about thermal and impact history of chondritic parent bodies. Northwest Africa 6485 (NWA 6485) is a sample of medium-grained crystalline rock of LL-chondrite material. Preliminary results suggest that NWA 6485 could be a partially fractionated chondrite melt that was re-heated due to a following impact event and then was slowly cooled.

Results: The rock has unbrecciated medium-grained poikilitic texture and consists of subhedral orthopyroxene grains of 200-300 µm in size that poikilitically enclose subhedral- to isometric olivine grains of 5-100 µm in size and minor feldspar (Fig. 1). The areas of this texture (~ 500 µm in size) are separated by interstitions comprised by the poikilitic olivine-feldspar aggregate with minor pyroxene. At places the areas seem to be co-oriented. The olivine $Fo_{70.3}$ (Fe/Mn=60 at.) is not fractured and has sharp extinction in crossed polars. The orthopyroxene $En_{72.4}Wo_{3.3}$ (Fe/Mn=35.5 at.; 0.2 wt% Cr_2O_3) contains irregular grains of clynopyroxene. Clynopyroxene ($En_{47.63}Wo_{40.4}$; 1.7 wt% Cr_2O_3) contains fine dissolution lamellae and inclusions of low-Ca-pyroxene with the lamellae of high-Ca pyroxene (Fig. 2).

The minor feldspar is growing in the interstitions of orthopyroxene grains and poikilitically enclose the olivine grains. Feldspar is $Ab_{82.3}An_{12.1}Or_{5.6}$. At places, the feldspar contains narrow (max. 2 µm width) parallel lamellae of orthoclase (Fig. 3). Modal abundance of orthoclase lamellae in the feldspar is <5 vol%.

Troilite (<1.5 vol%) forms xenomorphic grains of 50-200 µm in size in the interstitions of silicates. Some troilite grains associate with subhedral chromite crystals. Accessory chromite (2.5 wt% TiO_2) forms subhedral crystals in the feldspar grains. Olivine on the contacts with pyroxene or feldspar includes fine-grained symplectite-like intergrowth of chromite and low-Ca or high-Ca pyroxene. Other accessory phases are Ca-phosphate (probably, Cl-apthite), FeNi metal and Fe hydroxides. Modal composition of the rock is (vol%): Ol 34.7; Px 53.5; Fsp 11.7. Oxygen isotopic composition is (‰): δ17O 3.87; δ18O 5.15; Δ17O 1.19.

Discussion: The composition of minerals and oxygen isotope composition suggest origin of NWA 6485 from LL-chondrite material [2]. The rock is poor in troilite and FeNi metal in comparison with LL chondrites [3], that probably indicates a separation of silicate and metal-sulfide liquids. The meteorite was not shocked over 5 GPa [4]. The poikilitic texture of NWA 6486 differs it from the chondrite melt rocks [e.g. 5-6] and Type 7 chondrites [2]. A homogenous composition of the silicates and exsolved pyroxene and feldspars suggest slow subsolidus cooling of the rock. Symplectites of chromite and pyroxene are similar to those observed in various meteorites - [7] and refs. therein. The location and texture of symplectites and various composition of symplectic pyroxene possibly indicate that the symplectites were formed from the late Cr-rich magmatic liquid rather due to the subsolidus metamorphic reactions.

The most possible precursor of the NWA 6485 is LL chondrite impact melt. Its mineral composition corresponds to equilibrium crystallization in Ol-Px-Fsp system. However, a modal mineral composition of the NWA 6485 is different from that of LL chondrites [3] in high pyroxene and low olivine abundances.

The width of pyroxene lamellae is not large enough for analysis and thermometric applications. However, a two-pyroxene geothermometry [8] applied to coarse-grained coexisted pyroxenes in NWA 6485 indicates an equilibrium temperature ~1000°C, while antipertitic dissolution of the feldspar correspond to slow cooling of the rock below ~400°C.

The following scenario is proposed for explaining of the NWA 6485 composition and texture: 1) initial chondrite melt crystallized olivine; 2) olivine crystals were partially removed from the melt, probably together with metal and troilite by separation during the melt moving which is marked by co-orientation of the pyroxene-olivine areas; 3) remaining melt was slowly crystallized in equilibrium conditions and slowly cooled down to 1000°C. Impact re-heating probably up to T ≤500 did not affect to the pyroxene pairs composition, and followed slow cooling to T<400C° was resulted in the antipertites growth in the feldspar. It could be realized under the thick layer of high-temperature impactites.

Conclusion: NWA 6485 is a melt rock of LL chondrite but is different by texture, mineral modes and cooling rates from known chondrite melt rocks. Probably, NWA 6485 should represent an unknown type of impact deposits on the LL chondrite parent body.

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References: [1] Meteoritical Bulletine (2019) https://www.lpi.usra.edu/meteor/. [2] Hutchison R. (2004) In *"Meteorites: A Petrologic, Chemical and Isotopic Synthesis."* Cambridge University Press. [3] Dunn T. et al. (2010) *Meteoritics & Planetary Science*, 45, 123–134. [4] Stöffler et al. (1991) *Geochimica et Cosmochimica Acta* 55, 3845–3867. [5] Benedix et al., (2008) *Geochimica et Cosmochimica Acta* 72, 2417–2428. [6] Kuehner et al. (2017) *80th Meeting of the Meteoritical Society, LPI Contribution* No. 1987, Abstract #6273. [7] Khisina N. and Lorenz C. (2015) *Petrology* 23, 176–188. [6] Lindsley D. and Andersen D. (1983) *Proc. Lunar Planet. Sci. 13, JGR*, 88, Suppl, A887–906.

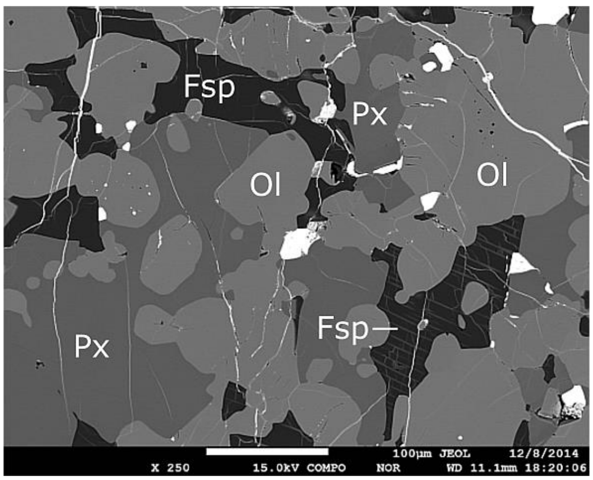

Fig. 1.

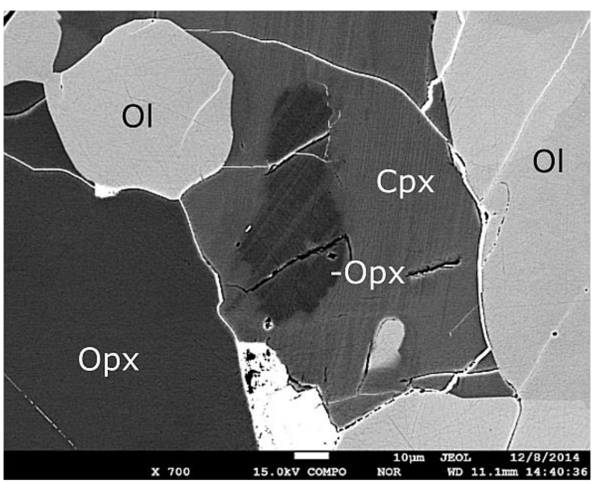

Fig. 2.

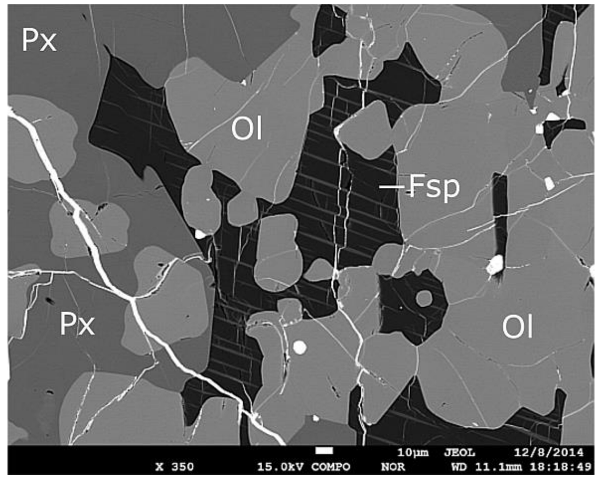

Fig. 3.

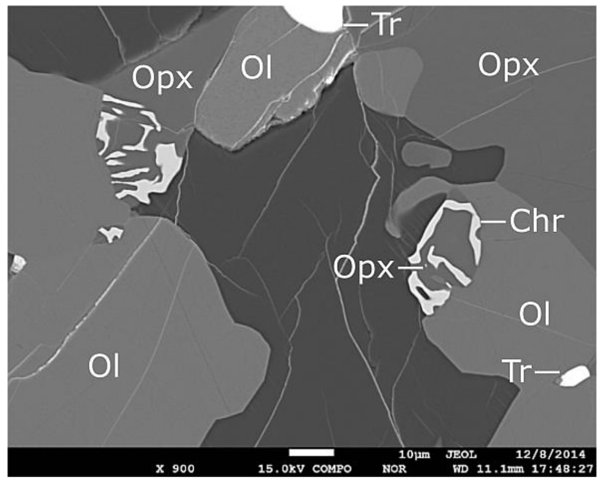

Fig. 4.

Fig. 1. A texture of NWA 6485.

Fig. 2. Coexisting pyroxenes and fine lamellar dissolution in the high-Ca pyroxene of the NWA 6485.

Fig. 3. Lamellae of orthoclase in the albitic feldspar.

Fig. 4. Symplectites of chromite and low-Ca pyroxene.

All figures are BSE images, Ol – olivine, Px - pyroxene, Opx – orthopyroxene, Cpx – clynopyroxene; Fsp – feldspar; Chr – chromite.