HELIUM IN NATIVE AND PROCESSED METALS. O. V. Yakubovich[1,2], A. V. Nesterenok[3], A. Carracedo[4] and F. M Stuart[4] [1]Institute of Precambrain Geology and Geochronology RAS, Makarova nab., 2, Saint-Petersburg, 199034, Russia (olya.v.yakubovich@gmail.com); [2]Saint-Petersburg State University, Universitetskay nab., 7/9, Saint-Petersburg, 199034, Russia; [3]Ioffe Physical–Technical Institute RAS, Politekhnicheskaya ul. 26, St. Petersburg, 194021, Russia alex-n10@yandex.ru, [4]Isotope Geosciences Unit, Scottish Universities Environmental Research Centre, Rankine Avenue, East Kilbride G75 0QF, UK Fin.Stuart@glasgow.ac.uk

Introduction. Inspired by the earlier work of Alfred Nier [1] and Boris Mamyrin and Igor Tolstikhin [2] that had observed significant amount of ^{3}He in some metals we report helium isotopes in several native minerals: gold, platinum, copper, silver, osmium and some processed foils: platinum, tantalum, aluminum. We suggested that the most reliable explanation of the observed excess of ^{3}He is its cosmogenic origin. To test this hypothesis we have determined the ^{3}He and ^{4}He concentrations of 16 samples: 3 processed metal foils, 8 gold nuggets from various deposits and samples PdPd, Pt_3Fe, OsIr alloys, native copper and silver. All natural samples are from alluvial placer deposits.

Methods: Samples were heated to melt temperature (where possible) directly using a 50 W diode laser. This approach does not involve heating other metal components and removes the possible memory effect of conventional UHV furnaces that may produce erroneously high ^{3}He concentrations [3]. Helium isotopes were measured on a Thermo Helix-SFT mass spectrometer.

Results: The processed metal foils yield small but similar scale excesses of ^{3}He or ^{4}He above the cold blank level. These amounts are a fraction of the totals measured in earlier studies [1]. The small excesses probably reflect a contribution of He from the heated Cu pan and sapphire cover glass and we use the average as the blank level to correct the He concentrations released by heating the native metals.

In the natural metals ^{3}He concentrations range from 2.6 x 10^{-14} to 1.6 x 10^{-11} cc/g. In all samples the ^{3}He/^{4}He ratios exceed values typical of radiogenic He. The ^{3}He/^{4}He ratio measured in gold is 72 R_a. The native copper nugget produced ^{3}He/^{4}He ratio > 300 R_a.

Disscussion. We suggest that the most realistic interpretation of presence of ^{3}He in all natural samples is that this helium has a cosmogenic origin. This hypothesis is supported by the absence of ^{3}He in the foils and that ^{3}He/^{4}He are higher than measured in any terrestrial reservoirs. Taking into consideration that all samples were derived from alluvial placers and these minerals are retentive during weathering and transportation they theoretically could have a good chance to accumulate significant amounts of cosmogenic ^{3}He.

Using the measured concentration of ^{3}He we calculate approximate exposure ages of these nuggets. Experience of ^{190}Pt-^{4}He dating native minerals of platinum and detailed study of a kinetics of helium thermodesorption from native metals led us to a conclusions that all helium release from the metals only when it is completely melted [4]. Thus native silver, PtPd and OsIr alloys can't be used for an accurate exposure dating (they were not completely melted). So we focused on exposure dating of 5 large nuggets: native gold from Fifeild and Gympie (Australia), Kara-Mas placer (Yakutiya, Russia), Pt_3Fe nugget from Kondyor deposit (Khabarovsk, Russia) and native copper from the Keweenaw deposit (Upper Michigan, USA).

For an accurate calculation of an exposure age it is necessary to know production rate of ^{3}He. However no ^{3}He production data is available for elements with mass close to Au and Pt. We roughly estimated production rate of helium for these minerals based on an empirical correlation between the existing production rates and the atomic number. Preliminary results gives us approximate exposure ages of these nuggets that range from 600 ka for the Kara-Mas placer deposit up to 6 Ma for native copper from Keweenaw deposit of Upper Michigan.

Conclusion. The robust nature of detrital native metals provides the potential to record a long record of Earth surface history. More extensive helium isotopic studies of native metals will be required to determine how well they preserve this record.

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