# High precision determination of the terrestrial $^{40}$K abundance

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$^{40}$K is one of the important constituents of the age equation used for K-Ar and K-Ca dating systems. The main sources of the uncertainty in K-Ca, K-Ar and $^{39}$Ar-$^{40}$Ar ages are the branching ratio of the $^{40}$K decay, the total decay constant and the abundance of $^{40}$K. The most recent reports [1] imply that the least precisely known term in the K-Ar age equation is the abundance of $^{40}$K. A $^{40}$K abundance of $(1.1672\pm41) \times 10^{-4}$ was measured on terrestrial material [2], which is to this day the basis of the IUPAC recommendation of the terrestrial K isotope composition. Its uncertainty of 0.35% is much higher than the goal of the EARTHtime initiative, i.e. a total absolute uncertainty of 0.1 % on the absolute age.

In order to improve on this situation we measured the abundances of the K isotopes in terrestrial standards NIST SRM 918b and 985 by thermal ionisation mass-spectrometry on a Finnigan TRITON instrument. Three measurement protocols combined with two amplifier set-ups were applied: (A) dynamic measurement with in-run normalisation to the IUPAC value $^{41}$K/$^{39}$K=0.072168; (B) a simple total evaporation procedure; (C) the "NBL-modified" total evaporation [3]. Two loading techniques and two types of filaments (tantalum and rhenium) were tested. The total ion yields (ionisation+transmission) were tested for the evaporation procedures (B) and (C) and ranged up to 48%. Isobaric interferences of Ca on K were tested and were not observed.

The results all agree with the terrestrial $^{40}$K/$^{39}$K ratio recommended by IUPAC, but have much higher precision. The most reliable results were obtained with the total evaporation protocol with an amplifier configuration that uses $10^{10}$, $10^{11}$ and $10^{12}$ $\Omega$ resistors on Faraday cups. The uncertainty of K-Ar and K-Ca dating systems contributed by the uncertainty of the $^{40}$K abundance are now reduced from 0.35% to 0.05%.

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# Re-Os isotope systematics of sulfides from Olympiada gold deposit (Yenisei Rige, Russia)

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The Olympiada Au deposit is located within the Yenisei Ridge in Central Siberia, along with a number of other Au and Au–Sb deposits. The Olympiada deposit occurs in metasedimentary terrigenous–carbonate rocks of Paleoproterozoic to Mesoproterozoic age, metamorphosed to amphibole–epidote greenschist facies. This deposit contains about 550–600 t of Au with the average grade of 3–4 ppm Au in primary sulfide ores and 10 ppm in supergene ores.

The Au mineralisation occurs in the contact zone between quartz–mica and carbonate–quartz–mica schists, and is controlled by a district-scale anticline, incorporating bedding-subparallel fractures and transverse fault zones. The orebodies are composed of carbonate–quartz–mica metasomatites containing 3–5 vol% sulfides (mostly arsenopyrite, pyrite, pyrrhotite, stibnite) and scheelite. Minor chalcopyrite, sphalerite, galena, tennantite–tetrahedrite and Bi-minerals are locally present.

Arsenopyrite is the main Au-bearing mineral and can be subdivided into 2 types according to mineralogical and chemical specific features: coarse-crystalline (Type 1) and acicular aggregates (Type 2), which represent distinct ore forming events differing by Au contents. First type is characterized by elevated contents of Au averaging 330 ppm, whereas Type 2 arsenopiryte contains only about 30 ppm of Au.

Both type of arsenopyrite were studied for isotopic composition of Re and Os. Type 1 arsenopyrite contains 3 ppb of Os and 20 ppb of Re and characterised by high $^{187}$Os/$^{188}$Os ratio up to 14. Type 2 arsenopyrite has lower Os and Re contents up to 0.5 ppb and 5 ppb correspondingly, together with low $^{187}$Os/$^{188}$Os raio of 0.3.

This difference implies different sources for these 2 stages of ore-forming process. Ore-forming fluids which forms gold-bearing arsenopyrites of the first type possibly have some crustal source. Origin of arsenopyrite of the second productive stage requires a source with mantle-like Os isotope signatures.