A new half-life measurement of ^{182}Hf

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The accuracy of geochronometers depends strongly on the accuracy and precision of the half-life of the parent nuclei involved. Recent improvements in mass spectrometry have led to large amounts of new data for radiogenic isotopic abundances at high levels of precision. However, the precision of decay-constants necessary for a reliable age determination is often not at the desired level (Begemann et al., 2001).

The ^{182}Hf–^{182}W system is a good example. It is the ideal chronometer for determining the timing of accretion and core formation of objects in the inner solar system (Halliday 2000). Yet among the important geochronometers the ^{182}Hf–^{182}W system has the largest uncertainty as far as the half-life is concerned. The previous value of (9±2) My was measured more than 40 years ago (Wing et al., 1961) using the ingrowth of the radioactive daugther ^{182}Ta (half-life = 114 days). Two other measurements exist. These were preformed directly in connection with discovery of ^{182}Hf and led to similar values: 8.5 My (Hutchin and Lindner, 1961) and (8±5) My (Naumann and Michel, 1961).

We are re-measuring the half-life of ^{182}Hf from the specific activity of some hafnium that was irradiated in high-flux reactors more than 30 years ago. The activity of ^{182}Hf is measured via γ-rays of excited states of ^{182}Ta following the decay of ^{182}Hf. The number of ^{182}Hf nuclei is determined by combining mass spectrometry (MC-ICPMS) and neutron activation. This new technique avoids possible errors due to the unknown sample matrix and allows a direct determination of self-attenuation of γ-rays, which can lead to a biased activity of the sample. Together with a second, independent measurement using isotope dilution to determine the total of the ^{182}Hf nuclei we will present a new, more precise value of the half-life of ^{182}Hf.

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Dating of ore forming processes in copper-porphyry deposits: Is U-Pb zircon the only suitable method?

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In the past the K-Ar and Ar-Ar techniques are selected to produce age information about young magmatic systems as well as about linked ore deposits. Suitable for those techniques are rock forming or alteration potassium-bearing minerals and in copper-porphyry deposits the obtained ages reflect the closing time of the isotope system (cooling to ≈ 300 °C).

For the studies at Cu-Au-(PGE) deposit Elatsite (Bulgaria) the U-Pb-zircon, Re-Os-molybdenite, Ar-Ar and Rb-Sr methods have been used to determine the life span of the porphyry system. Based on detailed field mapping, the time relationships between magmatic dykes, alteration processes and ore veins were obtained (Fanger, 2001). The selected samples marked the beginning as well as the end of the major ore formation. U-Pb zircon single grain analyses give for the beginning/ main ore formation (monzodiorite-porphyry body) an age of 92.1 ± 0.3 Ma; a second U-Pb zircon analysis for a later dyke (Q-diorite porphyry) of the main ore phase an intrusion age of 91.84 ± 0.3 Ma was obtained; U-Pb zircon analyses of granodiorite porphyry which mark the end of the major ore formation give an age of 91.42 ± 0.15 Ma.

Rb-Sr analyses of coarse-grained Bt and KFs, precipitated in irregular veins together with early mt-bn-chp assemblage determine a two point reference line, which slope corresponds to an age of 90.55 ± 0.8 Ma. Ar-Ar analyses of rock forming hornblende and biotite show ages of 90.78 ± 0.44 and 91.72 ± 0.7 Ma (Handler et al. 2002). The precision of both Rb-Sr and Ar-Ar methods were not good enough, but point rather more to cooling ages, then to the time of crystallisation of the minerals.

Recent Re-Os ages of molybdenites from Elatsite show an age range between 92.04 and 92.5 Ma (Zimmerman et al. 2003) and are in line with the U-Pb zircon ages. The obtained ages reflect the time of the Re-Os closing temperature of the ore mineral molybdenite and let the question about the life span of the ore-bearing magmatism open.

The combined use of several isotope methods shows the power of the U-Pb zircon dating of porphyry-copper deposits. Additional genetic information provide Hf isotope tracing of the same zircon (Quadt et al., 2002). The Re-Os dating of molybdenite offers a comparable robust and precise geochronometer for the timing of the high-temperature mineralising event, but failure with dating the life span of the mineralising system.