Tritium/helium-3 dating and fast changes of groundwater quality

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Human activity and climate fluctuations are major factors, affecting groundwater quality, first of all within the industrial areas. Forecasting of unfavorable consequences of these factors includes (a) experimental evaluation of aquifer flow and migration parameters, identification of pollutant sources, etc.; (b) mathematical simulation of flow and mass-transport.

$^3H/^3He$ dating [1] is an important tool to groundwater investigation on 50 yrs scale. As ^3H measurement is routine, the main dating procedure is to obtain tritiogenic ^3He amount by (a) measuring noble gas isotope abundances, and (b) subtracting non-tritigenic components of ^3He, e.g., dissolved and 'excess' air, etc. [2]. Isotope data and $^3H/^3He$ age can be used to estimate the young and old water mix proportions, as well as to verify and calibrate mathematical models of water flow and solute transport.

Isotopic approach has been applied to study different groundwaters at several sites in Russia with intense mining activity and/or radioactive wastes disposal. (1) $^3H/^3He$ dating, isotope (^{15}N, ^2H, ^{18}O) and chemical (SO_4^{2-}, Cl^-, NO_3^-, pH, Al) data enabled to map the recharge area, identify the main pollutant sources, assess the mixing proportions, and predict the changes in water chemical composition around apatite mines (Khibiny alkaline massif, Kola peninsula). (2) Data on ^2H, ^{18}O, ^3H, $^{3,4}He$, ^{20}Ne, $^{36,40}Ar$, $^{234}U/^{238}U$ in water and U, Th in water-bearing rock allowed to delineate the injection front and to quantify the migration parameters controlling radionuclide propagation in vicinity of deep wells injecting radioactive waste at the Siberian Chemical Combine (Tomsk-7). (3) $^3H/^3He$ dating was used for calibration of the flow and transport numerical models at St.Petersburg province potentially affected by research and industry reactors, as well as surface waste disposal facilities.

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U-Pb age and isotope data from the S- and I-type syn-collisional granites in the Ekecikdag area, central Anatolia

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Collisional granitoids in the Ekecikdag area (central Anatolia-Turkey), represent a S- and I-type igneous association formed by crustal melting related to the Alpine thickening during the Late Cretaceous. The I-type granodiorite characterized by the presence of K-feldspar phenocrysts and mafic microgranular enclaves together with its abundant biotite and hornblende content is calc-alkaline metaluminous based on whole-rock and mineral chemistry. The S-type granitoids with two-mica and lower mafic mineral content are peraluminous microgranite and metaluminous leucogranite. The Ekecikdag granitoids, in general, exhibit negative Ba, Nb, Sr, P, Eu and Ti anomalies, and Th, U, K, Pb and LREE enrichment on the primitive-mantle normalized spider diagrams. Whole-rock elemental and Sr-Nd isotope geochemical data indicate crustal magma sources with minor amounts of mantle contribution. Moreover, mineral chemistry data suggest an emplacement depth of 6-16 km for the granodiorite, and ≥10 km for the microgranite and leucogranite.

Mean LA-SF-ICP-MS zircon $^{2o6}Pb/^{238}U$ ages are between 80 and 85 Ma and considered as crystallization ages. Inherited zircon core ages, on the other hand, extend back to the Archean. Moreover, LA-MC-ICP-MS zircon Lu-Hf isotope analyses imply heterogeneous sources from the Archean to pre-Late Cretaceous, but the narrow range of isotope data obtained from the rims and younger zones of the zircons from the Ekecikdag granitoids (i.e., $\varepsilon Hf_{(t)}$: -1.3 ± 0.5 to -8.8 ± 0.5; $^{176}Hf/^{177}Hf_{(t)}$: 0.28250 to 0.28268) suggest a crustal homogenization at the Late Cretaceous.