Tracing anthropogenic nitrogen in the vicinity of industrial emitters in the Athabasca oilsands region, Alberta, Canada

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The Athabasca oilsands deposit in northeastern Alberta, Canada, constitutes an unconventional energy source that is becoming increasingly important as the supply of conventional oil decreases. However, the rapid expansion in the exploitation of this oil resource over the last few years has caused increasing concerns regarding potential effects of elevated nitrogen (N) deposition. Hence, monitoring of N deposition and a better understanding of the N cycle in the Athabasca oilsands region are crucial for a thorough assessment of the impacts of elevated N emissions and depositions on surrounding terrestrial and aquatic ecosystems. Stable isotope techniques were used to trace the sources and fate of anthropogenic N emitted from the oilsands development. We determined $\delta^{18}O$ and $\Delta^{17}O$ values of atmospheric nitrate and $\delta^{15}N$ values of nitrate and ammonium collected in bulk deposition at various distances from the industrial emission sources to gain a better understanding of atmospheric N cycling in the vicinity of the industrial emitters. $\delta^{15}N$ values of total N in bitumen and oil sand samples were ~2‰. $\delta^{15}N$ values of atmospheric nitrate and ammonium varied with season and distance from the industrial emission source. Biogenic nitrogen emissions appeared to affect the isotopic composition of atmospheric nitrate in the summer ($\delta^{15}N$ -4.9 to +1.9‰), while vehicle exhaust appeared to be a major NO_x contributor influencing $\delta^{15}N$ values of atmospheric nitrate in the winter (-2.0 to +6.3‰). $\delta^{15}N$ values of ammonium as high as +10‰ close to the emission stack are believed to be associated with NH_3 released by the bitumen desulfurization process. $\Delta^{17}O$ analyses on atmospheric nitrate (n=22) showed non-zero values (+15.3 to +32.0‰) and hence mass-independent isotope fractionation. There was a trend towards higher $\Delta^{17}O$ values of atmospheric nitrate with increasing distance from the emission source, confirming the anthropogenic origin of nitrate in the vicinity of Athabasca oilsands development. We conclude that isotope analyses on atmospheric N compounds can reveal important information about sources and fate of natural and anthropogenic N compounds.

High-temperature gold deposits of Transbaykalia (Russia): Ore fluids compositions and its connection with magmatic process

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There are some atypical gold deposits with high-temperature veinlets-dissiminated ore at the territory of East Zabaykaliya (Talatuy, Kariyskoe, Pilinenskoe and others). Except Au, from the ore of these deposits can be extracted Ag, Cu, W, Mo, Bi. The Main mineral ore assotiation – tourmaline-pyrite-magnetite. The early native gold has high fineness (up to 996‰), silver deposits in late associations under low temperatures. Alteration of host rocks are presented by prophilites and orthoklasites. Three types of fluid inclusions are recognized: (1) inclusions of chloride brine that contain a gas bubble, water solution, one or several isotropic crystals, and occasionally an opaque ore mineral; (2) substantially gas inclusions that contain gas with a thin rim of aqueous solution and an occasional cubic isotropic crystal; and (3) two-phase gas–liquid inclusions of diluted solutions. The results of thermo- and cryometric studies, which involved 440 individual fluid inclusions in quartz and calcite, indicate that Mg, Na, and occasionally Ca chlorides participated in the ore formation. The complete homogenization of brine inclusions is achieved at a temperature of 610–270°C, and the salt concentration amounts to 56.3–29.9 wt % NaCl equiv. The gas fluid inclusions are homogenized into gas at 590–290°C and contain a fluid with salt concentrations ranging from 33.8 to 0.9 wt % NaCl equiv. Some inclusions contain carbon dioxide. The pressure estimates based on the inclusions of this type are 1170–110 bar. The two-phase gas–liquid inclusions of diluted solutions are homogenized into liquid at 495–145°C. The salt concentration in solutions that fill inclusions varies from 23.2 to 0.4 wt % NaCl equiv. The chemical composition of fluid inclusion was studied. Fe, Cu, Mo, Zn, Pb, Au, Ag, Bi and the other elements were determined into fluid composition. The ore formation at the deposits of this type took place against the background of boil-off (heterogenization) of chloride fluid near the cooling magma pocket. The particularities of the chemical fluid composition witness about the occurrence of magmatic fluid. The thermodynamic model of gold and silver separation in such fluid-magmatic system was built.