

## GEOSCIENCES AND REMOTE SENSING

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GEOCHEMISTRY, ENVIRONMENTAL CHEMISTRY AND  
ATMOSPHERIC CHEMISTRY

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**Geochemistry of technogenic deposits in the city of Yakutsk****Vladimir Nikolayevich Makarov**

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We have studied the local technosphere in Yakutsk, consisting of seasonally thawing and frozen technogenic deposits that resulted from more than 300 hundred years of urban development. The Holocene alluvial deposits, from which hyper genic weathering products are derived, are slightly acidic, mixed-cation sulfate-bicarbonate type with approximately equal concentrations of ammonium and chlorides and low salinity, 0.025%/100g. The Quaternary alluvial deposits within Yakutsk are geochemically specialized for lithophile and chalcophile elements - B, W, Pb, Ti, Sn, Mo and Ag, whose concentrations are 1.2-2 times the natural abundance values. The alluvial sands and silts are poor in V, Co, Ni, Cu, and Hg. Geochemical modification of the technogenic deposits is greatest near the surface where the contrast of the chalcophile (Hg, Zn, Pb, Ag, Tl) and lithophile (B, Ti, Mn, Y) groups have significantly increased under the influence of anthropogenic impacts. The technogenic deposits have elevated pH, increased salinity with higher levels of bicarbonates, sulfates, and nitrates, as well as anomalous concentrations of heavy metals (Zn, Pb, and Hg) exceeding 2-3 times those in the underlying alluvium. The seasonally thawing and perennially frozen technogenic sediments are virtually homogeneous in geochemistry, but nearly all chemical elements have higher concentrations in the active layer. The nitrate concentration, however, is significant, almost an order of magnitude, higher in the permafrost compared to the active layer. An acidic geochemical barrier develops at the base of the technogenic deposits which may exist under alkaline conditions when strongly alkaline conditions change to weakly alkaline. These barriers concentrate anionic elements, including silica, B, V, Mo, As, S, and Cr, whose mobility is reduced in an acidic environment. The ability of these elements to form soluble anion and complex compounds in the alkaline environment significantly expands the range of their migration in technogenic deposits. In vertical extent, the chemical anomalies extend throughout the entire thickness of technogenic deposits down to the alluvial deposits. The thickness of technogenic anomalies depends on the duration of technogenic impact, concentration, and temperature gradient, and depth to geochemical barriers, reaching 7-9m for Hg, Na, NO<sub>3</sub><sup>-</sup>, S and Cl (salinity) and 5-6m for Ca, Mg, C, V, Mn, Co and Zn.

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