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The study of groundwater contamination hazard in megacities by mathematical methods (the cases of Moscow, Russia and Hyderabad, India)

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The paper discusses the results obtained within the framework of the Russian-Indian collaborative research project on the study of heavy metal migration in the vadose zone and aquifers within urban areas. The investigations have been carried out at the technogenically loaded key sites of two megacities, i.e., Moscow (Russia) and Hyderabad (India), facing the hazard of groundwater contamination from the surface sources.

For both sites, the content of heavy metals in soils and rocks near the contamination sources were analyzed by analytic chemical methods; the main factors influencing the transformation of chemical composition of deposits were revealed using the mathematical statistics; the migration of heavy metals in the aeration zone was assessed with HYDRUS 1D software; and the prediction of ground- and river water contamination was made using the numerical modeling of geofiltration and geomigration processes.

In both cases, the specific multielement pollution of deposits in the aeration zone, mainly by heavy metals, which controls the groundwater quality, is registered. The differences in the contamination level and the composition of pollutants are related to the geological factors, determining the specifics of element migration (the geological and tectonic structure of the area, as well as the lithological composition, properties and state of mantle deposits), on one hand, and technogenic factors (controlling the territory use specifics and pollutants composition), on the other hand.

The geological structural and hydrogeological differences between the key sites justified the application of different hydrogeological models for the investigation of heavy metals migration in the aeration zone and in the aquifers, i.e., the double-porosity model, the continuum model, as well as the model accounting for the variable fracturing of granite massif and the one, making allowance for the hydrogeological windows.

The predictive assessment of hazard of soils and groundwater contamination with heavy metals have been performed for the period of 100 years and permitted to trace the preferable migration routes for the contaminants.

