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Abstract

Keywords

1. Introduction



1.1. Geological setting

1.2. Mine hydrology

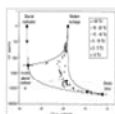
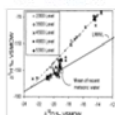
Table 1

2. Sampling and analytical procedures

3. Results and discussion

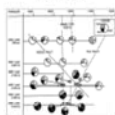
3.1. Groundwater salinity

Table 2

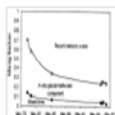
3.2. Origin of mixing components— ^{18}O , ^2H and Cl^- 

3.3. Mixing calculations

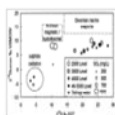
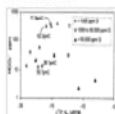
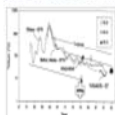
Table 3



3.4. Spatial and temporal distribution of water types in the mine



3.5. Mixing and geochemical evolution

3.6. Modelling rates of modern groundwater circulation with ^3H 

Journal of Hydrology

Volume 235, Issues 1–2, 22 August 2000, Pages 88–103



Groundwater mixing dynamics at a Canadian Shield mine

M. Douglas^{a, 1, 1}, I.D. Clark^a, K. Raven^{b, 2, 2}, D. Bottomley^{c, 3, 3}^a Department of Earth Sciences, Ottawa-Carleton Geoscience Centre, University of Ottawa, 140 Louis Pasteur, P.O. Box 450, Stn. A, Ottawa, Ont., Canada K1N 6N5^b Duke Engineering and Services, 265 Carling Avenue, Suite 208, Ottawa, Ont., Canada K1S 2E1^c Atomic Energy Control Board, Waste and Decommissioning Division, 280 Slater St., Ottawa, Ont., Canada K1P 5S9[http://dx.doi.org/10.1016/S0022-1694\(00\)00265-1](http://dx.doi.org/10.1016/S0022-1694(00)00265-1), How to Cite or Link Using DOI
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Abstract

Temporal and spatial variations in geochemistry and isotopes in mine inflows at the Con Mine, Yellowknife, are studied to access the impact of underground openings on deep groundwater flow in the Canadian Shield. Periodic sampling of inflow at 20 sites from 700 to 1615 m depth showed that salinities range from 1.4 to 290 g/l, with tritium detected at all depths. Three mixing end-members are identified: (1) Ca(Na)–Cl Shield brine; (2) glacial meltwater recharged at the margin of the retreating Laurentide ice sheet at ~10 ka; and (3) modern meteoric water. Mixing fractions, calculated for inflows on five mine levels, illustrate the infiltration of modern water along specific fault planes. Tritium data for the modern component are corrected for mixing with brine and glacial waters and interpreted with an exponential-piston flow model. Results indicate that the mean transit time from surface to 1300 m depth is about 23 years in the early period after drift construction in 1979, but decreases to about 17 years in the past decade. The persistence of glacial meltwater in the subsurface to the present time, and the rapid circulation of modern meteoric water since the start of mining activities underline the importance of gradient, in addition to permeability, as a control on deep groundwater flow in the Canadian Shield.

Keywords

Groundwater; Canadian Shield; Mixing; Environmental isotopes; Geochemistry; Brine; Tritium; Con Mine; Radioactive waste

Figures and tables from this article:



Fig. 1. Map of the southern area of the Con Mine showing mineralized shear zones, faults, and surface water bodies in the area sample. The drift sections represent the north–south limits between regular sampling locations at each level, and illustrate the westerly offset of drifts with increasing depth.

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