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Distribution of Upper Pliocene brines in the northern Jordan Rift Valley, Israel and Jordan

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In the triangle of Lake Tiberias (LT), Yarmouk Gorge and Lower Jordan Valley (Fig. 1), fresh groundwaters are frequently deteriorated by variable admixture of ascending subsurface Upper-Pliocene brines. Element ratios and water isotopes reveal, that common source brine is present and is modified by water rock interaction and dilution with freshwater. This common source brine is inferred from the composition of the known Ha'on well brine being characterized by molar ratios of Na/Cl=0.53, 1000Br/Cl=5.5 and Ca/Mg=0.39 (Möller et al., 2011). The low Ca/Mg, a ratio also found for Newe Ur, is unique in an environment in which ratios >1 dominate because of omnipresent dolomitization of abundant limestones. Interaction with abundant intrusive basaltic bodies would add sodium and hence increase the low Na/Cl ratio to >1. Uptake of halite increases Na/Cl but decreases Br/Cl ratios. These ratios resemble seawater after 37-fold enrichment in Li molality by evaporation (McCaffrey et al. 1987). Although being diluted by freshwater the Ha'on well brine proves the presence of an evaporated seawater mother brine residing at unknown depth. The derivatives of inferred Ha'on mother brine are present around Lake Tiberias, in the lower Yarmouk Valley and in the northern Rift Valley at least as far southwards as Newe Ur. Areas of structural weakness, where the major fault systems occur, are the main distribution areas for these brines. The study provides an example whereby hydrochemical analyses are applied as key tool to better understand deep fluid transport processes at basin-scale, which are supported by numerical modeling of groundwater flow.

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McCaffrey M.A., Lazar B., Holland H.D. (1987): The evaporation path of seawater and the coprecipitation of Br- and K+ with halite. J. Sediment. Petrol. 57: 928–937.