Response to comments on an article entitled 'A geochemical survey of spring water from the main Ethiopian rift valley, southern Ethiopia: implications for well-head protection' by McKenzie et al., Hydrogeology Journal (2001) 9:265–272

Jeffrey M. McKenzie · Donald I. Siegel · D. Jonathan McKenzie

We thank Seifu Kebede and Yves Travi for their comments regarding our paper: "A geochemical survey of spring water from the main Ethiopian rift valley, southern Ethiopia: implications for well-head protection" (McKenzie et al. 2001). However, it appears that Kebede and Travi misinterpreted the intent of our paper, which was to address how local isotopic variations and changes in shallow spring-water chemistry in southern Ethiopia may be used to address issues related to well-head protection. Kebede and Travi criticize us for not citing the larger body of literature on the isotopic composition of waters elsewhere in Ethiopia. Because our paper was written as a local isotopic and geochemical case study, we are perplexed why Kebede and Travi suggest that we should cite isotopic and geochemical composition of waters from lakes, boreholes, and thermal springs from northern and central Ethiopia in different physiographic and climate regions. Much of the literature to which Kebede and Travi refer is not pertinent to the intent and content of our paper, and some of it is not easily found in normal channels of searching for peer-reviewed earth science literature. Kebede and Travi even suggested we cite data from ongoing unpublished research (IAEA TC project ETH/OO6 2002).

Kebede and Travi also question our interpretation of published stable isotope values for Ethiopian precipitation: These data are scarce with the exception of Addis Ababa, where precipitation has been analyzed intermittently since 1961 (IAEA/WMO 2001). For pragmatic reasons, these Addis Ababa isotope data have been used as the precipitation end member in groundwater flow and hydrologic water budget studies in Ethiopia, and most investigators have assumed that the Addis Ababa Local Meteoric water line of δD=6.95 δ^{18}O+19 (Rozanski et al. 1996) generally applies for Ethiopia.

Obviously, "local" meteoric water lines may differ from the one at Addis Ababa (Darling 1996; Darling et al. 1996). We used the isotopic composition of water in shallow springs and seeps as a proxy for local precipitation, a method often used in remote places where data on the isotopic composition of multi-year precipitation is lacking. We feel that Fig. 1 shows that our data and proxy meteoric water line are not significantly different from the scatter of Addis Ababa precipitation.

The significant scatter of the isotopic composition of Addis Ababa data suggests that a blind regression of Addis Ababa meteoric isotopic composition probably produces a meteoric water line locally unsuitable for many regions of Ethiopia (Darling and Gizaw 2002). Addis Ababa precipitation almost shows two trends: one that is very close to that of the Global MWL, and another trend with a lower slope (Fig. 1). One possibility of the isotopic scatter of precipitation at Addis Ababa may be the re-evaporation of precipitation as it falls (Clark and Fritz 1997). There may be other reasons as well.

We do not claim that the isotopic altitude effect we observe in our study necessarily can be used elsewhere in Ethiopia. The reason we used the altitude effect in our research was to show the robustness of using stable isotopes of water from small springs and seeps as a proxy for local precipitation. We agree that the altitude effect is not easily measured, and may be easily dominated by non-altitude related effects. However, our data speaks for itself: the isotopic composition of the waters in the shallow springs and seeps we sampled varies according to an elevation difference of 1,000 m. In contrast, samples of deep groundwater do not show a similar altitude effect,

Received: 28 December 2002 / Accepted: 2 January 2003
Published online: 3 April 2003

J. M. McKenzie (✉) · D. I. Siegel
Department of Earth Sciences, 204 Heroy Geology Laboratory,
Syracuse University,
Syracuse, NY 13244, USA
e-mail: jmmckenz@syr.edu
Fax: +1-315-4433363

D. J. McKenzie
229 Regina Street,
New Westminister, V3L 1S7 Canada

 DOI 10.1007/s10040-003-0253-9

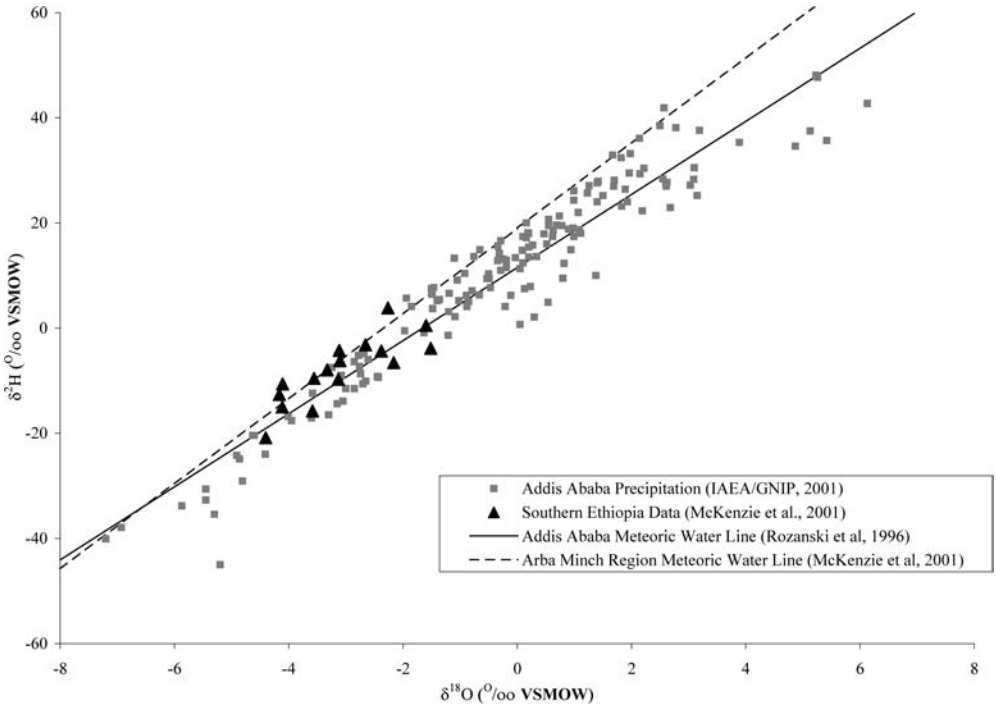

Fig. 1 Plot of δD versus δ^{18}O comparing data and local meteoric waterline from southern Ethiopia (McKenzie et al. 2001) versus that of Addis Ababa (Rozanski et al. 1996; IAEA/GNIP 2001)

confirming that they had undergone other processes and were not appropriate proxies for precipitation.

Finally, we inadvertently listed a major source of water to the Ethiopian Rift as being the Mediterranean Region. We agree that the correct source for most of the water to the Ethiopian Rift Region is the Indian Ocean.

Summarizing, our research was to investigate well-head protection for small springs used for drinking waters in southern Ethiopia. Our geochemical and isotopic results show that a relatively simple "spring-cap" protection system provides a safe, potable source of water for people living in the study area, which is the fundamental point of our paper.

References

Clark ID, Fritz P (1997) Environmental isotopes in hydrogeology. Lewis Publishers, New York

Darling WG (1996) The geochemistry of fluid processes in the eastern branch of the east African rift system. PhD Thesis, Open University, Milton Keynes

Darling WG, Gizaw B (2002) Rainfall–groundwater isotopic relationships in eastern Africa: the Addis Ababa anomaly. Study of environmental change using isotopic techniques. C&S Papers Series, IAEA 12/P, pp 489–490

Darling WG, Gizaw B, Arusei MK (1996) Lake groundwater relationships and fluid rock interaction in the east African rift valley, isotopic evidence. J Afr Earth Sci 22:423–431

IAEA TC Project (2002) An ongoing project conducted by International Atomic Energy Agency, the Ethiopian Science and Technology Commission and the Ethiopian Geological Surveys. ETH006

IAEA/WMO (2001) Global network of isotopes in precipitation. The GNIP database. Accessible at: http://isohis.iaea.org

McKenzie JM, Siegel DI, Patterson B, McKenzie DJ (2001) A geochemical survey of spring water from the main Ethiopian rift valley, southern Ethiopia: implications for well-head protection. Hydrogeol J 9:265–272

Rozanski K, Araguas-Araguas L, Gonfiantini R (1996) Isotope patterns of precipitation in the East African region. In: Johnson TC, Odada E (eds) The limnology, climatology, and paleoclimatology of the east African lakes. Gordon and Breach, Toronto, pp 79–93

 DOI 10.1007/s10040-003-0253-9