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Extended Abstracts

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Environmental and artificial tracers in hydrogeology

title: Groundwater age and paleoclimate information derived from environmental tracers in a regional aquifer system in semiarid Northwest India

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INTRODUCTION AND STUDY AREA

Stable isotopes and noble gases in groundwater in combination with dating based on ^{14}C and He are well-established tools to derive paleoclimate records. This study aims to provide the first noble gas temperature record from tropical south Asia. The regional aquifer system in the Cambay Basin situated in Northern Gujarat, India, is suitable for climate reconstruction over the last 30 to 50 ka (Agarwal et al., 2009). The region has a semi-arid, monsoon-dominated climate. In such a climate, stable isotopes and excess air may hold information about past changes in monsoon intensity (Kreuzer et al., 2009). Dating is provided by tracers such as SF_6, ^{222}Rn, ^{4}He, ^{14}C and ^{3}H–^{3}He. Sampling campaigns took place in early 2008 and 2009, following two transects along the groundwater flowpath (lines A'–A and B'–B in Fig. 1). Samples were collected from wells equipped with submersible pumps at farms and villages.

PRELIMINARY RESULTS

^{4}He and ^{14}C data confirm an increasing age with flow distance along the transects, enabling the use of He as an age proxy. Exceptions are thermal springs in the area, which show a strong radiogenic He component and high ^{222}Rn concentrations at large well depths. SF_6 concentrations in groundwater are abnormally high in some wells; possible correlations with He and Rn still have to be investigated. As SF_6 of natural origin appears to be prevalent, the use of this tracer as a dating tool is prevented.

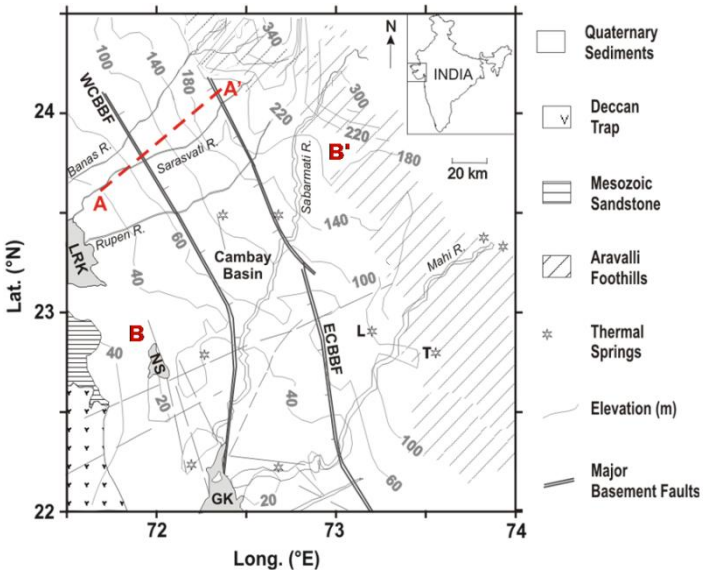

Figure 1. Map of the North Gujarat – Cambay region showing sampled transects.

$\delta^{18}O$- values obtained in 2008 along the northern transect increase with age, i.e., decrease from glacial towards modern times (Fig. 2). This trend may be a signal of increasing precipitation amount, i.e. a strengthening monsoon over the past ~20 ka. While stable isotopes show a rather linear trend, the deuterium excess exhibits an abrupt change around 7 ka (Fig. 2).

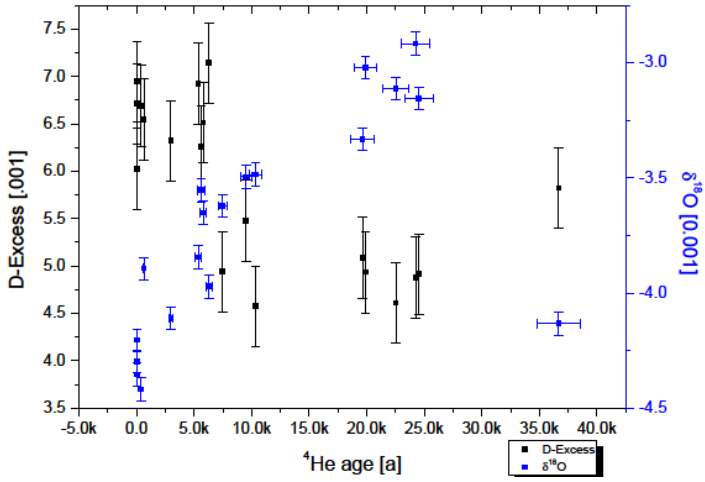

Figure 2. $\delta^{18}O$ and deuterium excess of the northern transect versus groundwater age.

Noble gas temperatures (NGTs) of both transects show a general drop in temperature with increasing age. NGTs in the recharge area are around 29°C (north) to 31°C (south) and are well reflected by recent groundwater temperatures in the recharge area, while being higher than the local mean annual air temperature (27.5°C at Ahmedabad). Cooler NGTs in older samples show a drop of around 2.5°C (north) to 4°C (south). Nonetheless, the temperature scatter in the recharge area is quite high, which may be due to an interference with older, deeper aquifers, as wells accessing the shallow aquifers in the recharge area are quite rare.

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