Heterogeneity of the Bengal Aquifer System and security of As-safe deep groundwater

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Representing heterogeneity of the Bengal Aquifer System

The vulnerability of deep wells in the Bengal Aquifer System (BAS) to contamination by arsenic (As) is governed first by the geometry of induced groundwater flow paths to the wells and second by the geochemical conditions encountered between the shallow and deep regions of the aquifer [1]. Groundwater flow paths are sensitive to basin geometry and to the heterogeneity of basin sediments, in addition to the natural and imposed hydrological regime. The BAS has been represented at basin-scale as a single, vertically anisotropic, homogeneous aquifer [2]. To explore the refinement necessary for assessing vulnerability at specific locations, we have incorporated data from over 600 borehole logs to a depth of 350 m across a 5000 km^2 region of SE Bangladesh in a series of representations of BAS [3], at increasing levels of detail applying (1) anisotropy, (2) spatial heterogeneity and (3) hydrostratigraphy.

Aquifer representations for modelling As transport

Groundwater flow models based on these aquifer representations provide adequate simulations of head, but contrasting implications for well catchments and travel times. To judge which representations are better for transport, model outcomes have been compared with independent groundwater age determinations. Comparisons demonstrate the importance of incorporating aquifer spatial heterogeneity, and implications for the security of As-safe deep groundwater in the BAS.

[1] Burgess *et al*. (2010) *Nature Geoscience* **3**, 83 – 87, [2] Michael & Voss (2008) *PNAS* **105**: 8531-8536, [3] Hoque (2010) *PhD thesis (unpublished).*

Pliocene-Pleistocene record of sea-ice expansion in the North Pacific

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Extensive sea-ice formation in the Bering Sea has the potential to impact the distribution and sequestration of gases and nutrients in the oceans through deep/intermediate water formation. Therefore, the history of sea-ice expansion in this high-latitude region is important for understanding feedback mechanisms related to climate change. Core U1341 (IODP exp 323 Bering Sea) used in this study covers the early Pliocene to Pleistocene, including the early Pliocene warm period (~5–~3 Ma) when the mean global temperature was ~3ºC warmer than today [1] and the onset of Northern Hemisphere Glaciation (NHG), which was well-developed by 2.6–2.7 Ma.

We measured neodymium (Nd) isotopes of the detrital fraction of bulk sediments. Nd isotopic values range from +6.5 to -8 (εNd units) for the last 5 Myr, and can be divided into 3 phases; (1) a stable period with values at +5 εNd (5– ~3.2 Ma), (2) a dramatic unidirectional decrease from +5 to -8 (~3.2–2.1 Ma), and (3) a period of rapid fluctuations between +6 and -6 εNd (0–2.1 Ma). Nd isotopic values in the Holocene are radiogenic, reflecting input of volcanic particulates from the Aleutian arc, while less radiogenic values during the LGM reflect delivery of Alaskan-origin IRD (Ice-rafted debris) by seasonal expansion of sea-ice to the Bowers Ridge [2]. Given the distinct Holocene and LGM detrital Nd isotopic values, the initial radiogenic Nd isotope interval (5–~3.2 Ma) suggests that sea-ice had not yet expanded to site U1341. In contrast, the shift toward less radiogenic Nd isotopes (~3.2–2.1 Ma) indicates that sea-ice started to expand ~3.2 Ma. This timing coincides with sea-ice expansion in the North Atlantic [3], suggesting synchronous cooling in the high-latitude NH. The interval of rapid fluctuations (0–2.1 Ma) may reflect changs in sea-ice extent related to pronounced Glacial-Interglacial cycles during the Pleistocene; however, age constraints for this portion of the record do not yet allow us to confirm this correlation.

[1] Haywood and Valdes (2004) *EPSL* **218**, 367-377. [2] Horikawa *et al*. *Geology* (accepted). [3] Jansen *et al*. (2000) *Paleocenography* **15**, 709-721.