Time series and water balance models to assess the climatic variability and land use effects in Kabini river basin, South India

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In the last two decades, significant changes have taken place in the semi-arid areas of the Kabini river basin (an area of 10^4 km^2 and a sub-basin of Cauvery river basin) in the south of India on the use of groundwater for irrigation. This has resulted in systematic changes in land use practices especially in the upland areas, which were not part of the traditional canal irrigation. Depletion of water tables due to over-extraction of groundwater has become a critical issue in some parts of these areas. However, the impacts are found to be non-uniform across the region due to the heterogeneity in terms of aquifer characteristics of the hard-rock system, spatio-temporal pumping patterns of micro-scale land parcels, variations in the soil types and in addition the spatial variability of the recharge.

The Empirical orthogonal functions (EOF) are applied to analyse the spatial and temporal signatures of the behavior of the rainfall and the groundwater in 66 piezometers monitored during the last three decades in the semi-arid zone of the Kabini river basin. It was observed that the presence of strong decadal variations in rainfall such as droughts along with recent trends of heterogeneous land use changes provide distinct groundwater signatures in the system at various scales. The approach helps in delineating the non-uniform spatial clusters in the groundwater system resulting due to the various factors discussed above. Singular spectrum analysis (SSA) is applied to study the rainfall, stream flows and groundwater levels in the system to analyze comprehensively the long-term climatic effects on the regional system and to assess the relative impacts of anthropogenic forcing. The respective roles of climatic and land use variability on the groundwater recharge and discharge components are simulated at nested scales (10^4 km^2 to 10^2 km^2). The recharge is also estimated using chloride mass balance method along the climatic gradient of the Indian summer monsoon in the Kabini basin. These results show the usefulness of the approaches developed for the sustainable development of the groundwater system under changing hydro-climatic scenario.

Fast transportation of volatiles simulated by shock experiments; Implication for fast magma transportation

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Magma generation brings about variety of physical and chemical processes for the evolution and global techtonics of the Earth. Sudden and fast magma transportation occurs as dynamic, non-equilibrated process that has been not fully understood yet. We need experimental investigations to simulate such processes. Expansion of volatiles in magmas in the process of magma transportation can be modeled by shock wave experiments. We investigate the release states from the compressed state (Hugoniot state) using *in situ* observing technique (VISAR). Figure 1 illustrates the target for our shock experiment. Shock wave, generated by hypervelocity impact, propagates through the sample and window. If the window material has a lower shock impedance, the wave profile of VISAR indicate a velocity change corresponding to the pressure drop in the partially release states. We used a very low impedance material (a silica gel with a density of 0.1 g/cm^3). This method has been applied for basalt sample [1] and will be applied for hydrous mineral powders including bassanite that was investigated by recovery shots [2].
The pressure range in the present study is up to about 10 GPa. We also checked the experimental results with a numerical result using the impedance match method.

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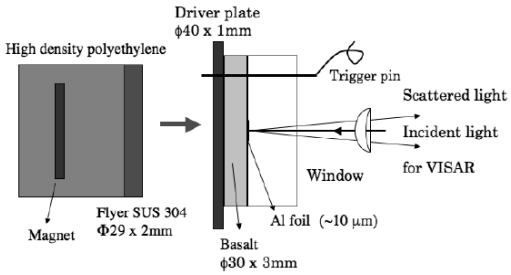

Figure 1: Experimental set-up for *in situ* measurements.

[1] Sekine *et al*. (2008) *Earth Planet. Space* **60**, 999-1003. [2] Zhang & Sekine (2007) *GCA* **71**, 4125-4133.