Sr and $^{87}\text{Sr}/^{86}\text{Sr}$ in waters and sediments of the Brahmaputra river system: Silicate weathering, CO$_2$ consumption and Sr flux

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Abstract

The Brahmaputra is a major river system draining the Himalaya. The concentration of Sr and its $^{87}\text{Sr}/^{86}\text{Sr}$ have been measured in dissolved and particulate phases of the Brahmaputra and its tributaries in India to trace the sources of dissolved Sr. Dissolved Sr ranges from 250 to 1050 nM with $^{87}\text{Sr}/^{86}\text{Sr}$ from 0.71298 to 0.75975. The Sr data along with the available concentrations of major ions in the samples show that major contributors of Sr in the Brahmaputra system are the silicates and carbonates of the Himalaya and the Transhimalaya and carbonates and evaporites of the Tibetan basin. Silicate Sr in the Brahmaputra river system ranges from 20% to 80% with an average of $\sim$45%. The silicate component of Sr in the Brahmaputra system is similar or marginally higher than that in the Ganga system due to contribution from the Transhimalayan calc-alkaline plutonic rocks which have higher concentration of Sr. Evaporites of the Tibetan sub-basin and hot springs along the Indus Tsangpo Suture could be the other significant contributors to the dissolved Sr budget of the Brahmaputra. Contribution from evaporite dissolution decouples the total dissolved Sr flux from the Tibetan basin from atmospheric CO$_2$ consumption. Radiogenic Sr of the Brahmaputra system is derived from the Himalayan silicates whereas other Sr sources tend to dilute its radiogenic signature. The $^{87}\text{Sr}/^{86}\text{Sr}$ of the dissolved phase shows significant correlation with indices of silicate weathering, indicating that $^{87}\text{Sr}/^{86}\text{Sr}$ can serve as a proxy of silicate weathering. At their outflow, the Brahmaputra is less radiogenic ($\sim$0.72) compared to the Ganga ($\sim$0.73), however, the flux of $^{87}\text{Sr}$ from the Brahmaputra is similar to that of the Ganga.

Keywords: Himalaya; Brahmaputra; $^{87}\text{Sr}/^{86}\text{Sr}$; Weathering

1. Introduction

It is well established that the $^{87}\text{Sr}/^{86}\text{Sr}$ of seawater has been steadily increasing since the Cenozoic (Burke et al., 1982; Depaolo and Ingram, 1985; Hess et al., 1986, 1989; Veizer et al., 1999). This increase has been attributed to the rise of the Himalaya during this period and associated enhanced silicate weathering (Palmer and Elderfield, 1985; Raymo et al., 1988; Richter et al., 1992). Support for this hypothesis comes from the tectonic history of the Himalaya and the high concentration of dissolved Sr in the Himalayan Rivers and their highly radiogenic $^{87}\text{Sr}/^{86}\text{Sr}$ (Palmer and Edmond, 1989; Krishnaswami et al., 1992; Richter et al., 1992; Galy et al., 1999). These in conjunction with the radiogenic nature of Sr in silicate rocks of the Himalaya,