Small scale catchment perspective of weathering in the Deccan Basalt, India and its climatic and hydro-geomorphic controls

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Impact of climate and geomorphic variability on chemical weathering were analysed by studying two adjacent small catchments with uniform lithology of basalt but contrasting climatic settings. The west flowing Ambika river with 2640 km^2 area have average annual rainfall 2000 mm which decreases sharply to 800 mm/year over 3590 km^2 basin area of east flowing Girna river. Major and trace elements of dissolved and particulate loads in these river basins were analysed to evaluate rock-water interaction, element mobility, chemical denudation rates, and factors controlling them. The hydro-geomorphic framework along with sub-basin wise discharge were derived using semi-distributed hydrological model SWAT. The mixing plot of Ca/Na vs. Mg/Na and Ca/Na vs. HCO_3/Na of dissolved load showed that sample clusters were between silicate and carbonate mixing line at upstreams and few clusters indicated mixing trend between silicates and evaporites especially at downstrems. Total chemical denuadation estimated at the outlet of these basins were 390 $tonkm^{-2}y^{-1}$ and 43 $tonkm^{-2}y^{-1}$ respectively for west flowing humid and east flowing semi-arid basin. Silicate weathering rates (SWRs) calculated using forward modelling showed that River Ambika (west flowing humid basin) have around 3-4 fold more SWR than River Girna (east flowing semi-arid basin). SWRs were estimated as 89±13 $tonkm^{-2}y^{-1}$ and 28±4 $tonkm^{-2}y^{-1}$ respectively for west and east flowing rivers at the outlets. Si/HCO3 act as proxy for basalt to smectite conversion showed smectite conversion were more prominent in upstream regions of both the catchments. Climatic parameters namely rainfall and runoff were dominant controlling parameter for the chemical weathering rates. The geomorphic factors viz., slope and relief further act as secondary controls on chemical weathering and its impact was better noticed in semi-arid basin compared to humid basin.