Sources of dissolved silica in north Patagonian rivers (44–48°S): The importance of volcanic ash soil distribution and weathering

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Dissolved silica (DSi) plays an important biogeochemical role in the fjords of northern Chilean Patagonia (44–48°S), where it drives high biogenic productivity and promotes carbon burial. It is generally believed that the DSi riverine input to lake and coastal environments is controlled by a combination of factors including lithology, climate, topography, and meltwater input. In northern Chilean Patagonia several authors have proposed that the postglacial volcanic ash soils may play a significant role in the high supply of DSi to the regional fjords. To assess the influence of andosols on DSi concentrations in north Patagonian rivers, we mapped andosol thickness and compared our results to river chemistry. We also investigated the mineralogical and geochemical composition of three representative andosol profiles to evaluate the efficiency of weathering processes. The andosol thickness map clearly demonstrates that volcanic ash was predominantly deposited on the eastern side of the regional volcanoes, reflecting the influence of the prevailing westerly winds on the distribution of pyroclastic material. Mineralogical and geochemical results show that the andosol parent material has the typical andesitic basaltic signature of the regional volcanoes. Down-profile variations in soil mineralogy and geochemistry indicate increased leaching of silica with depth, resulting from weathering of the volcanic parent material. For the five studied watersheds, a highly positive correlation ($r=0.99$, $p<0.001$) was found between average andosol thickness and DSi concentrations, suggesting that andosol thickness is the main parameter affecting DSi concentrations in north Patagonian river systems. On seasonal timescales, precipitation and glacial meltwater input can significantly reduce DSi concentrations. We argue that the weathering of andosols constitutes the most important source of DSi to the lakes and fjords of northern Chilean Patagonia, which explains the particularly high regional rates of biogenic silica production.