

Mineralogical control on the chemistry of the Girdiman River water.

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The Greater Caucasus (GC), composed mainly of sedimentary rocks, offers an ideal setting to study river water-rock interactions and their impact on water chemistry. This study examined the Girdiman River in eastern GC, spanning 88 km and draining 727 km². Water and sediment chemistry were determined and used to investigate water-rock interactions.

Sediment mineralogy, determined by X-ray diffraction, was dominated by calcite and quartz with muscovite showing relatively higher concentrations in the middle reaches than at the upper and lower ends of the river. The chemical compositions of the sediments, determined by X-ray fluorescence, were dominated by SiO₂ (ranging from 27.4% to 65.4%) and CaO (0.65% to 29.4%) in the upper reaches, whereas Al₂O₃ (6.8% to 19.3%) replaced CaO in the lower reaches. River water samples were tested for pH and electrical conductivity on-site, as well as for their elemental composition. To assess the influence of various geological units on water chemistry, both sediment batch and flow-through experiments were conducted.

Cluster analysis identified four major groups according to sediment mineralogy—one group was dominated by carbonates, while the others were primarily composed of aluminosilicates.

The pH of the river water ranged from 7.0 to 8.5, likely influenced by the dissolution of carbonates. Calcium (43 ppm) was the predominant cation in the water, reflecting the high presence of calcite and anorthite in the sediments. Magnesium decreased and Na increased as dolomite content in the sediments declined and feldspar content rose. Silicon (3.83 ppm) showed relatively higher concentrations in the upper and middle sections of the river. Aluminium and iron were found in low concentrations due to their low solubility and tendency to form secondary minerals through precipitation.

Results from the flow-through experiment, performed on four sediments identified as typical using cluster analysis indicated that the major cations rapidly released from carbonates and aluminosilicates. Calculated experimental solution saturation levels (PHREEQC modelling) were identical to the chemical composition of the river water.

Studying geochemical behaviours in the Girdiman River catchment provided insight that carbonates predominantly govern river water chemistry in the upper reaches, whereas aluminosilicates exert greater influence in the middle and lower reaches.