

Water quality map of rivers in the eastern Shimane and western Tottori Prefectures

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This study aims to create maps showing the water quality of rivers in the eastern Shimane and western Tottori Prefectures, in order to provide fundamental information for the sustainable use of the river water. This area is widely composed of granitic rocks with local distributions of Miocene sedimentary rocks in the coastal area and Quaternary volcanic rocks of Mt. Daisen in the eastern area. It is active in agriculture and fishery as well as metal mining from the Edo period including Tataro iron-manufacturing. Further the atmosphere is affected by materials and pollutants from the Sea of Japan and the Asian continent by westerly winds. Human activities in the watershed from the past and recent changes in the atmospheric environment would affect the aquatic ecosystem in this area. To evaluate these effects on the freshwater quality, we determined the compositions of four stable isotopes and fifty-five dissolved components for totally 291 stream water samples, which were collected during base-flow periods of spring to autumn from 2009 to 2011. Analytical results are summarized as follows:

1. Geological contribution: Sr isotope ratios in stream water varied in accordance with the watershed geology; 0.705 - 0.706 in Mt. Daisen area, 0.706 - 0.707 in many areas with the acidic igneous rocks, and 0.707 - 0.709 in the coastal Miocene rock areas. There is a positive correlation between Ca and Sr contents, indicating that both elements are largely derived from Ca-minerals through chemical weathering. Many trace elements such as Ba, Cs and V also displayed a geographical variation dependent on the watershed geology, demonstrating that they are utilized as a hydro-geological tracer.

2. Atmospheric contribution: The concentrations of Cl and Na decreased regularly from the northern coastal area to the southern mountainous area, indicating the inland decrease of sea-salt inputs through the atmosphere. The very high values of seawater component in the stream water of Shimane Peninsula suggest that this peninsula has been acting as a topographic barrier, possibly suppressing the sea-salt impact from the Sea of Japan to Matsue and Izumo Cities. Water isotope ratios also tended to decrease, whereas deuterium-excess value (d-value) to increase, with distances from the Sea of Japan. Stream waters with low water isotope ratios and high d-values (20 - 23) distribute in the mountainous area of southeastern Shimane, where the precipitation of snow is high. Stream waters of Shimane peninsula had high SO₄ concentrations (10 - 30 mg/L) and low d³⁴S values (-2 - 5 per mil), indicating a dominant source of rock sulfur. In contrast, most streams in the Hiigawa watershed had low SO₄ content (2 - 6 mg/L) and high d³⁴S value (8 - 12 per mil), indicating that the Hiigawa sulfur is enriched in marine sulfur and anthropogenic one from the Asian continent rather than granite-derived sulfur. The integrated use of Cl, SO₄, and water and sulfur isotopes are powerful as a hydro-atmospheric tracer.

3. Anthropogenic contribution: The concentration of NO₃ tended to be high in the lower reaches where the anthropogenic effect is expected to be large. The distribution of Fe was similar to those of Cr, As and Se, but they did not show any meaningful relationship with areas where the Tataro mining took place.

Keywords: Riverine water quality map, Strontium isotope ratio, Hiikawa River System, Hinogawa River System