

Monthly monitoring of multiple water-quality to diagnose the linkage between surface water and groundwater in the Saijo plain, Ehime prefecture

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Coastal plain of Saijo city in Ehime prefecture is divided into eastern Saijo plain and western Shuso plain, and is known to be rich in groundwater irrespective of low precipitation in the Setouchi district. This is ascribed to be the presence of Ishizuchi mountainous area in the back of the plain, where the amount of precipitation increases with elevation. For the sustainable use of the groundwater, we collected samples of groundwater and river water over the whole plain area in cooperation with residents of Saijo city. Spatial analysis for the concentrations of 54 elements and stable isotope ratios of H, O, S, and Sr of these water showed that (1) the groundwater is divided into several areas dependent on the watershed and flow areas, and (2) the unconfined groundwater in the eastern plain flows in shallow aquifer recharged from the head of alluvial fan of the Kamo river, whereas the artesian water, which is representative and good quality of Saijo citizens, flows in deeper aquifer recharged from more mountainous area. Based on this finding, we started to monitor water-quality monthly at two Kamo river sites (Funagata bridge and Isonohashi bridge), Ohmachi elementary school site for shallow groundwater, Uchinuki hiroba site for artesian groundwater, and Tokumasu house site for a mixture of both waters. Temporal analysis of water quality data obtained during 2007 to 2015 is summarized as follows:

(1) The concentrations of most elements (Sb, As, V, Rb, Si, Al, Ti) in river water become high in summer and low in winter or spring, whereas those in groundwater at the Ohmachi site are high in winter and low in spring or summer and those in groundwater at the Tokumasu site are high in autumn and low in winter or spring. From the temporal analysis of these water-quality data, we can estimate the flow rate of the shallow groundwater to be about 10 cm per day.

(2) This seasonal variation is not so distinct for most elements in the artesian water at the Uchinuki site; the concentrations of Cl, B, Na, Sb, and As increase, whereas those of Ca and Sr decrease monotonously with weak seasonal change. Other elements (Si, V, Mg, Ti, SO₄) show more complex variation. This result indicates that the recharge area and flow rate of the artesian water differ significantly from that of shallow one, and other water source in addition to the Kamo river is involved.

It is concluded that the monthly monitoring of water quality is effective to evaluate the linkage of the surface water and groundwater system, but further continuous monitoring is required especially for elucidating the flow system of artesian water.

Keywords: groundwater, surface water, monitoring, flow rate, water quality diagnosis, recharging area