

## Development of multi-tracer of water toward Asian geo-isoscape study

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Research Institute for Humanity and Nature (RIHN), an Inter-university Research Institute Corporation, aims to elucidate the linkage of interactions between human activity and natural environment. Most elements have stable isotopes (SI), which are known to be powerful as a tool to promote this linkage study. RIHN has been establishing an analytical system to get multiple SI information, and will assure the proper use of this system and support its accessibility in order to propel cooperative studies through RIHN and related projects. As such an attempt, RIHN starts the geographical mapping of multiple SI and elements for environmental materials in collaboration with local universities and research institutions.

Quality of fresh water is a function of human activities and natural environment such as industry, climate, geology, vegetation, and so on. The concentrations of dissolved elements and the ratios of SI in groundwater and surface water at base-flow periods are temporally stable, while they are spatially variable. This indicates a potential that the water quality can be served as indexes to characterize the local environment and the traceability information of ecosystem and biological body since water is indispensable for the life of biota and the ultimate source of most elements in biota is attributable to water. Accordingly, the geographical map of SI and dissolved components in fresh water is fundamental for environmental studies such as water circulation, pollution, ecological and health risk, source identification of agricultural products and food, which are main problems of global environment to be solved urgently. However, in order to apply the water-quality map for water management and to extend it for exploring a new science, SI researchers should cooperate with local autonomies and citizens and with scientists of other disciplines, respectively. Building the data-base system of SI in different spatial scales is also prerequisite for these purposes. I will introduce an application example of this map into environmental diagnosis and water management in Saijo city of Ehime prefecture and its extension to joint studies in Japan and East Asia through RIHN projects.

Saijo city is known to be rich in groundwater of good quality and uses the water for drinking, agriculture and other industries. By working with municipal organization, we collected more than 1000 samples of groundwater and 400 samples of surface water in the city and determined the compositions of 50 elements and stable isotopes (H, O, S, N, Sr, and Pb). Comparison of both waters have elucidated the impact of atmospheric deposition to the surface water, the recharging area and flow route of the groundwater, and human impacts of the two waters (nitrate pollution by excess use of fertilizer, salt intrusion by over pumping, antimony pollution by abandoned mine, industrial waste disposal etc). For example, map of water isotope ratios and chlorine concentrations have successfully visualized the flow direction of groundwater from its recharging area. Based on this map, we started the biweekly to monthly monitoring of water quality over three years, which have shown the geological structure, flow rate, and salt intrusion process of groundwater.

In order to enhance environmental literacy of citizens, we have been returning obtained results into Saijo citizens through symposium and book. The SI map can contribute to studies of food-web analysis, identification of habitat of plant, trace of animal behavior as well as social problems of the source identification and false description of food. This collaborative map study is conceptually analogous to isoscape project in U.S.A. The water quality map shows a wide geographical variation of multiple tracer components in different scales. RIHN calls for universities and research institutions to join this map study, which aims to explore an academic seed and meet social needs for environmental management.

Keywords: water-quality map, stable isotope, water management, environmental diagnosis, environmental tracer, database