

Regional characterization of river and spring waters by trace element signature

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Development of analytical techniques for chemically specifying the production place of foods are expected for food safety. We have been developing analytical techniques for the provenance analysis of foods. From last year, we started an investigation of river water and spring water designated “the best 100 natural water sources in Heisei period1)” Water is a key material for provenance analysis of agricultural and forest commodities, because water is one of essential resources in the cultivation of vegetables and agricultural crops. It is thus expected that trace element information of water will be an important indicator for distinguishing the production area. The purpose of the present study is to confirm the idea that trace element signature of water reflect the local geology and hence that of a plant reflects the geology of the area.

Natural water samples from 40 points (16 rivers and 24 springs) were collected into polyethylene containers with 3% Nitric acid and have been stored in a cold dark place (~4°C). Any precipitates in water samples were removed by a filtration using a membrane filter (pore size 0.45 μ m) prior to the analysis. Na, Mg, K, Ca, and Si were analyzed by using ICP-AES (inductively coupled plasma emission spectrometer: SPS3520UV), other trace elements were analyzed using a quadrupole ICP-MS (mass spectrometer: Agilent 7500c). REE (Rare earth elements) were concentrated before analysis with Novias chelate resin. ¹¹⁵In was added to each water sample as an internal standard. Concentrations of more than 20 elements in the water samples were quantified by a calibration method.

At first we look for possible sources of characteristic trace elements in water samples detected by our analyses. We have observed that concentrations of Li were characteristically high in the river water samples from Arakawa river (Fukushima Pref.), Kanna river (Gunmma Pref.), and Kinpusan Mizugakiyama (Yamanashi Pref.). We have noticed that source rivers of these rivers flow granite geology. It is found that concentrations of Li in the other river waters running without granitic geology were not so high. Therefore, it is possible to say that Li may reflect the granite geology. It is found that spring water of

“Yuminosyouzu” in Toyama prefecture shows high concentrations of REEs. Sedimentary rocks are widely distributed in the vicinity of “Yuminosyouzu”. It is estimated that weathering of apatites contained in the sedimentary rocks may elute REE as phosphates2). Similarly, the highest concentrations of Mg and Ca among analyzed samples were observed in water samples from the “Matsumoto Joukamati Yuusuigun” in Nagano Pref. Mg is thought to be influenced by tuff stone accumulating in the vicinity of the source Utukushigahara Plateau and Ca is considered to be influenced by limestone3).

From these observations, it is found that trace element compositions of the spring and river waters tend to reflect their background geology. We will further analyzed water samples all over Japan to find key elements which may reflect origin of water and to apply these information for provenance analysis of foods and woods.

1) S. Yabusaki et al.: Journal of Groundwater Hydrology 51, 127-139 (2008) (in Japanese).

2) S.J. Köhler et al.: Chemical Geology 222, 168-182 (2005).

3) S. Yabusaki: Bulletin of Geo-Environmental Science, 13, 33-41 (2011) (in Japanese).

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