

## **Geological investigation of the speleothems in limestone caves, Korea**

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### **Abstract**

There are more than 1,000 limestone caves in South Korea. The caves are mostly distributed in the lower Paleozoic carbonate rocks (Joseon Supergroup) of the central part of the peninsula. Textural and geochemical investigation of the speleothems has been carried out to understand the original mineralogy, formation processes and carbonate diagenesis, using coordinated textural, isotopic and elemental data. Among the speleothems studied, curtain (also bacon sheet), fried-egg stalagmite, cave shield, and rimstone are solely composed of calcite, and anthodite is composed of aragonite. However, cave coral, stalactite, stalagmite, flowstone are composed of aragonite and/or calcite. Based on the textural observations of more than 500 speleothem samples, five types of aragonitic and ten types of calcitic texture could be categorised.

The aragonitic speleothems show higher Sr and lower Mg contents than calcitic ones. All the speleothems from different caves show their distinctive Sr and Mg compositions, indicating that the fluids responsible for the formation of the speleothems had the different Sr and Mg contents according to locality. The  $\delta^{18}\text{O}$  values range from  $-9.4$  to  $-4.0$  ‰ (PDB) and those of cave water and adjacent stream water range from  $-10.7$  to  $9.3$  ‰ (SMOW), suggesting that most of the speleothems formed in oxygen isotopic equilibrium, except for some enriched aragonitic speleothems. These enriched aragonitic speleothems may indicate that they were formed by evaporation rather than degassing of carbon dioxide. The  $\delta^{13}\text{C}$  values are quite variable from  $-10.0$  to  $-5.0$  ‰ (PDB). These values are between the carbon isotopic compositions of the measured organic carbon in overlying soils and those of the carbonate rocks surrounding the limestone caves. Based on the mass balance calculation about 10 to 25% of the carbon in speleothems studies were from the organic carbon in overlying soils.

Some of the originally aragonitic speleothems such as cave coral, stalactite, and flowstone in a few caves have been calcitised. The neomorphic calcite crystals contain relics of the original aragonite crystals and growth laminae. The presence of these relics in neomorphic calcite as well as the similar elemental contents to the original aragonite suggests that the calcitisation processes took place in a semi-closed system via thin-film alternation front.