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Cave minerals as archives and proxies of palaeoenvironmental changes

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Cave minerals encode records of environmental changes in their mineralogy, crystallography, habit, and chemical characteristics. Most palaeoclimate and palaeoenvironmental reconstructions from cave deposits are, however, based on the chemical parameters extracted from cave $CaCO_3$, calcite and the less common, thermodynamically unstable phase aragonite. Other environmentally important cave minerals, such as gypsum, opal, sulphur, iron and manganese oxides and hydroxides, have not yet attracted the interest of the palaeoclimate community, despite the wealth of information they may potentially provide on the environmental changes that controlled their deposition in caves. Gypsum speleothems, for example, are not rare, as they can be observed in caves from Northern Russia to Italy, Spain and Central America, that is in a variety of different environmental settings.

After presenting an short overview of calcite and aragonite as palaeoenvironmental archives from a crystallochemical and morphological perspective, the role played by the calcite/gypsum ratio within speleothems in gypsum caves as a general indicator of palaeoclimate variations (from hot to cold, from dry to wet) will be discussed, because climate has a direct consequence on their depositional mechanisms, namely evaporation for gypsum and diffusion for calcite. Case studies regarding replacement of calcite by opal and aragonite in a cave subjected to volcanic influence and located in southern Korea, sulphur growing over gypsum in a sulphide-rich cave of Italy, and growth of iron oxides-hydroxides will be shown to provide information on the palaeoenvironmental changes in particular caves and in their regional setting.