Genetic algorithm as a correlation tool – speleothems stable isotope records example

J. Pawlak and H. Hercman

Institute of Geological Sciences, Polish Academy of Science. ul. Twarda 51/55 Wasaw, POLAND

ABSTRACT - CL5.4/NP4.5 Climate Time Series Analysis

The isotopic composition of oxygen and carbon in cave speleothems is a valuable source of paleoenvironmental information. Oxygen isotopic composition reflects the mean annual temperature at the cave area and the isotopic composition of the infiltering water. Carbon isotopic composition reflects the level of development of soil and vegetation type at the surface.

Calcites from cave speleothems can be usually dated by U- series method but U-series method has limitations. One of the most critical is cleanest of analysed calcite. Any detrital admixtures make contamination by initial thorium and dating results are not reliable. In such a situation there is a problem with the time scale estimation of isotopic data.
Oxygen stratigraphy of carbonate marine sediments base on the correlation of oxygen isotopic sequence from studied profile with the global standard curve. Similar solution could be applied to the isotopic profiles obtained from cave speleothems. In this case any isotopic record can be correlated with a record which has well defined age. Such correlations can be made on the basis of arbitrary decisions of the researcher however, such procedure may be suffered by subjectively evaluation. Therefore we decided to develop a tool that will enable the correlation of isotopic profiles.
Cave speleothems grown with a variable crystallization rate, so similar stretch of time can be represented by the sediments of varying thickness. The process of correlation of isotope curves consists on free shifting of data points (accordance with the rule of superposition) belonging to the record with undetermined age, relative to the record with well defined age. Each generated position is evaluated. The best position is accepted as a true position. Such procedure requires the use of an algorithm, which is able to efficient search of large (almost infinite) set of possible positions. Genetic algorithm is a tool that could find the optimal solution in a set of large number of solutions. On the presented poster, we will present genetic algorithm application for isotopic record correlation. Constructed algorithm was tested on artificial and real data sets (stable isotope records from speleothems).