Constraining the Sr isotopes signature in surface waters draining granite-gneiss by atmospheric and anthropic inputs correction

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Introduction

As part of the geological characterisation program to assess the feasibility of an underground laboratory in granitic formation, the Vienne district, located in the north-west part of the French Massif Central, has been largely documented by the governmental agency ANDRA (e.g., Agence Nationale de Gestion des Déchets Radioactifs). The aim of this study is to characterise the geochemical signature of surface waters in a geologically contrasted district in order to characterise the potential recharge of the deeper layers and investigate the water-rock interactions.

Results and discussion

Sampling has been performed in springs and lakes for major and trace elements analyses, stable isotopes (O and D) and Sr isotopic composition.

A double correction of water signature was performed, e.g. (1) atmospheric input and (2) anthropic addition. The atmospheric correction is based on a rain monitoring over one year and major and trace concentrations and Sr isotopic compositions are weighted by the amount of precipitation. Chloride, assuming a conservative behaviour and the evaporation factor were used as reference. After correction, all samples, excepted one, present residual chloride, reflecting the influence of anthropic inputs. Anthropic correction has been done only for Sr isotopic composition and Sr concentrations because of the difficulty to assess the different anthropic endmembers.

The concept of the double correction allows defining the real range of isotopic signature of water draining the various granitoids of the Vienne district. Therefore, the comparison with the theoretical signature calculated with a geochemical model of dissolution can be performed (Négrel et al., 2000). Values are in good agreement for the investigated granites, taking into account the error propagation in the theoretical dissolution model.

This study has allowed characterising water-rock interactions in the superficial zone (e.g. alterite and fissured part of granite), probably representative of deeper conditions in a context of low temperatures weathering reactions. A great variability of the strontium isotopic signatures in waters draining the same batholith was evidenced.

References

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The carbon isotopic composition of terrestrial organic matter in the late Paleozoic: clues to deciphering the landplant-atmosphere interaction

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The late Paleozoic is marked by substantial changes in the cycling of carbon among different reservoirs of the global carbon cycle. The evolution and rapid spread of higher land plants since the late Silurian has been a predominant parameter affecting the exchange of carbon between the atmosphere, hydrosphere and lithosphere. Particularly, the observed rise in the $\delta^{13}C$ for carbonate and organic carbon during the late Paleozoic is largely attributed to the higher fractional burial of organic matter in sediments due probably to the evolution of resistant plant remains (e.g., lignin), and the spread of peat forming environments.

Based on a systematic survey of terrestrial organic matter, we present a carbon isotope record for the late Paleozoic. Well preserved plant fossils, detrital organic matter from decidedly terrestrial successions, and coals served as sample material for this study. A wide palaeogeographical distribution and different types of continental environments with a good stratigraphic control were considered.

To date, we have measured $\delta^{13}C$ values for over 450 samples ranging in age from the late Early Silurian (Wenlock) to the Permian-Triassic transition. Our results are supplemented by data from the literature. The average isotopic composition varies between -27‰ and -23‰ with a band width of 2-9‰. No systematic variations exist with respect to different sample material, thermal maturity of the samples, and sedimentary facies (rock-type), suggesting that the primary isotope signal of the plants has been preserved.

The $\delta^{13}C$ values for Paleozoic organic matter are quite comparable to modern C_3 plants. Thus, we compare our data with a calculated dataset, based on a model for modern C3-photosynthesis fractionation by Arens et al. (2000). The carbon isotope record for marine carbonates (Veizer et al., 1999) serves as a proxy record for the $\delta^{13}C$ of atmospheric CO_2. The temporal evolution of the measured terrestrial organic carbon isotope record is in overall agreement with the calculated dataset. Furthermore, our data document the linkage between the terrestrial and the oceanic realm via the atmosphere.

Assuming that, on a global scale, the main parameter affecting the carbon isotopic composition of plant tissue is the $\delta^{13}C$ of atmospheric CO_2, we can show that the comparatively heavy $\delta^{13}C$ values for late Paleozoic landplants (mean: -23.5‰ compared to modern C3 plants at -27‰) are a consequence of the respective $\delta^{13}C$ for atmospheric CO_2.