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Does dawsonite preserve mantle CO_2 signature? Implication for CO_2 origin at Covasna, eastern Transylvania, Romania

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One of the most discussed topic concerning global climate change is global CO_2 emanation. One source for the outgassing CO_2 is the Earth's mantle where CO_2 as an inert gas migrates through fault zones to the surface and the atmosphere contributing to its carbon budget. The internal part of the Carpathian bend area in Romania hosts a large number of CO_2 emanation spots. One of them, Covasna spa, South-eastern Transylvania, is a famous locality in the Carpathian-Pannonian region for its abundant CO_2 outflows, both dry – mofettes, and wet - carbonated mineral waters. In the uninhabited vecinity of the town carbonate precipitation in the form of dawsonite deposition, along with realgar and orpiment, was observed and studied. Dawsonite, a hydrous carbonate mineral - $NaAlCO_3(OH)_2$) -, records and preserves δ^2H, $\delta^{13}C$ and $\delta^{18}O$ values of the migrating deep-sourced CO_2 as well as of the associated H_2O. Furthermore, CO_2-carried noble gas isotopic ratios can also be used for origin determination. Our stable isotope study on dawsonite shows a mixing-line trend between mantle source – gained from freshly emanated CO_2 (extracted from spring water) – and the atmosphere, respectively. The dawsonite δ^2H values (-47.7 to -53.9 ‰) show similarities with the δ^2H isotopic composition (-48.4 to -50.9 ‰) of the CO_2-rich spring water. Calculated $\delta^{13}C$ values of dawsonite (-2 to -4 ‰), presumably in equilibrium with CO_2 during mineral formation, fall in the same range as in the measured CO_2 gas phase (-2 ‰) which may suggest mantle origin. We conclude that this mineral is potentially able to preserve the original stable isotopic fingerprint of the CO_2 emanations to which it is genetically related in the study area. The high emanation rates of possible mantle-origin CO_2 is most likely linked to the faults cutting through the thin-skinned nappe structure of the area whose dynamics is connected to the major tectonic discontinuity between the suture zone of the Carpathian Belt and the Moesian platform basement.