Study of water uptake mechanisms in plants living in gypsum

Laura de la Puente[1*], Sara Palacio[1], Gabriel Montserrat[2], Juan P. Ferrio[3]
[1]Department of Biodiversidad y Conservación., IPE- CSIC Avenida Nuestra Señora de la Victoria, 16, 22700 Jaca, Huesca, Spain; [2]Department of Biodiversidad y Conservación, IPE-CSIC Avenida Montañana 1005, 50059, Zaragoza, Spain; [3] Agrifood Research and Technology Centre of Aragón (CITA) Avenida. Montañana 930, 50059 Zaragoza, Spain. *Correspondence: delapuente@ipe.csic.es

Gypsum has water in its crystalline structure (CASO4 • 2H2O) and depending on the temperature, pressure or presence of solutes this water can be naturally lost. Crystallization water represents 20.8% of the total weight of gypsum and previous studies show that it constitutes a source of water for organisms living in this substrate, especially under drought conditions. However, the mechanisms displayed by plants to gain access to crystalline water remain unexplored. Similarly, the ecological implications that this new source of water can have for the structure of the communities and their ecophysiology is unknown.
Here we present a set of experiments being currently undertaken to shed light on these issues.

- The gypsophite *Helianthemum squamatum* (Fig 1) is being cultivated in pots with natural gypsum soil and soil where the crystalline water has been labeled with deuterium. Half of the pots of each soil type have been sterilized with γ-radiation and subsequently watered with a filtrate incorporating a natural soil bacteria inoculum, so as to produce fungus-free soil. We plan to over-impose a drought treatment to half of these plants and measure the differences in water uptake and in gypsum crystalline water use. This will inform on the role of fungi for crystalline water uptake.
- *H. squamatum* and its sister gypsovag species *Helianthemum* syriacum (Fig 2) are being cultivated in rhizotrons with fungus-free soil and natural soil (following γ-sterilization and addition of a bacteria filtrate) where changes in the pH of the rhizosphere will be monitored (Fig 3). This will indicate the ability of these plants to modify gypsum soil pH.
- We have designed mini-rhizotrons (Fig 4) compatible with crystallographic measurements and are cultivating *H. squamatum* in them. Plants will be subjected to drought and different analyses (Raman spectrometry, gas-exchange, XR-D, tomography) will be carried out at the plant and root-soil interface to detect changes in the thermodynamic phases of gypsum and gypsum dissolution processes mediated by root activity.
- Finally, to detect differences in the use of crystalline water among plants growing in the same community, we carried out a field survey of the xylem sap of 20 dominant species of the gypsum community in Alfajarín, Zaragoza both in spring and summer, and characterized the isotopic composition water table and soil water along three 1 m depth soil profiles.


Fig. 1. *H. squamatum*


Fig 2. *H. syriacum*

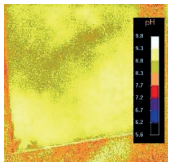
Fig. 3. Monitoring image


Fig. 4. Minirhizotron