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Drinkable rocks: plants can use crystallization water from gypsum

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Some minerals hold water in their crystalline structure. Such is the case of gypsum ($CaSO4•2H_2O$), a rock forming mineral present in the arid and semi-arid regions of the five continents, including the dry most areas of the planet. Gypsum is also extensively found on Mars, where it constitutes a targeted substrate for the search of life. Under natural conditions and depending on the temperature, pressure, and dissolved electrolytes or organics, gypsum may lose crystallization water molecules, becoming bassanite (i.e. hemihydrate: $CaSO4•\frac{1}{2}H_2O$) or anhydrite (CaSO4). As crystallization water can account for up to 20.8% of gypsum weight, it has been suggested that it could constitute a relevant source of water for organisms, particularly during summer. This suggestion is consistent with the phenology observed in some shallow-rooted plants growing on gypsum, which remain active when drought is intense, and with the increased soil moisture of gypsum soils during summer as compared to surrounding non-gypsum soils. Here we use the fact that the isotopic composition of free water differs from gypsum crystallization water to show that plants can use crystallization water from the gypsum structure. The composition of the xylem sap of gypsum plants during summer shows closer values to gypsum crystallization water than to free soil water. Crystallization water represents a significant water source for organisms growing on gypsum, especially during summer, when it accounts for 70-90% of the water used by shallow-rooted plants. These results significantly modify the current paradigm on water use by plants, where water held in the crystalline structure of mineral rocks is not regarded as a potential source. Given the existence of gypsum on the surface of Mars and its widespread occurrence on arid and semi-arid regions worldwide, our results have important implications for exobiology, the study of life under extreme conditions and arid land reclamation.