The hidden CO_2 - The occurrence, distribution and composition of fluids in various salt minerals

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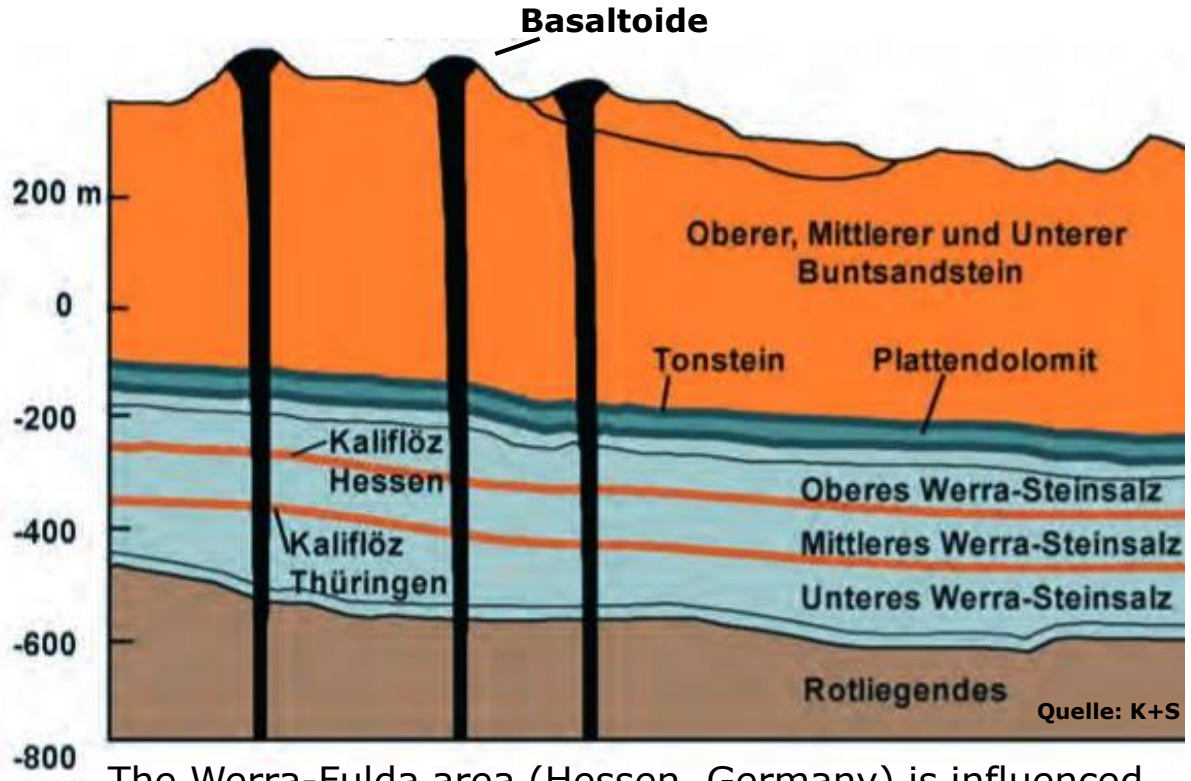
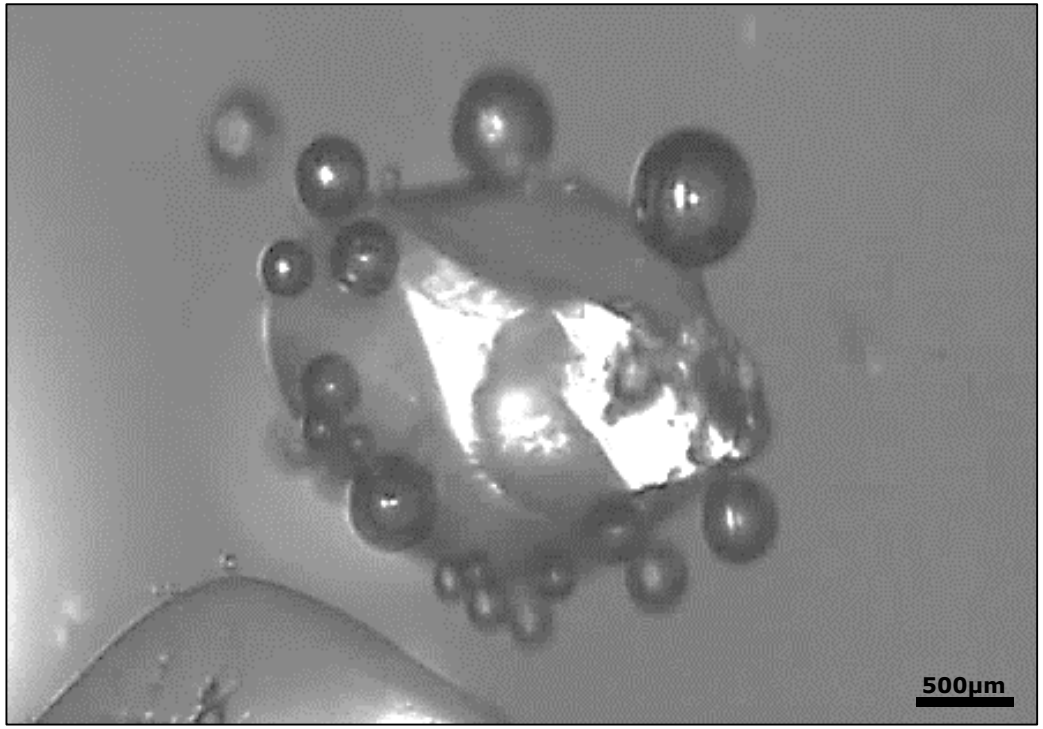
Motivation, Background



The Werra-Fulda area (Hessen, Germany) is influenced by tertiary volcanism that caused an geologic overprint due to basic magmatism accompanied by geogenic CO_2.



Salt rocks of these area often contain large amounts of CO_2-rich gas. Shown here, a mineral grain under the microscope exposed to water.

Therefore fluid inclusions with variable CO_2 concentration are expected.

Sample Origin and Methods

layered salt deposits in the mining area

Mineral chips and polished section under the microscope and Raman spectroscope

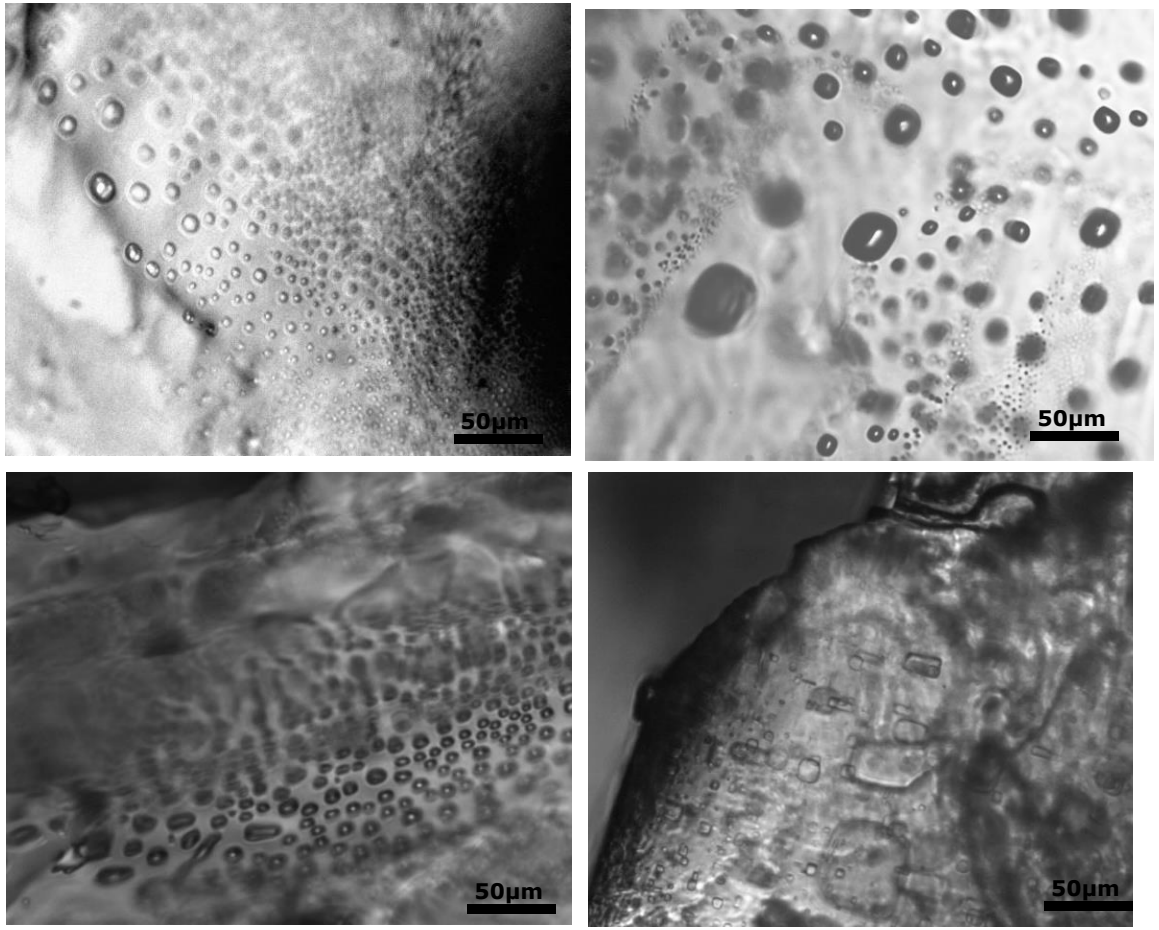
Sampling location: Werra-Fulda potash mining district, an area of layered salt deposits with local overprint of geogenic CO_2-dominated gas

Host minerals: halite, sylvite, kieserite and carnallite

Preparation: clear hand-cut mineral chips and polished section of about 100 µm thickness

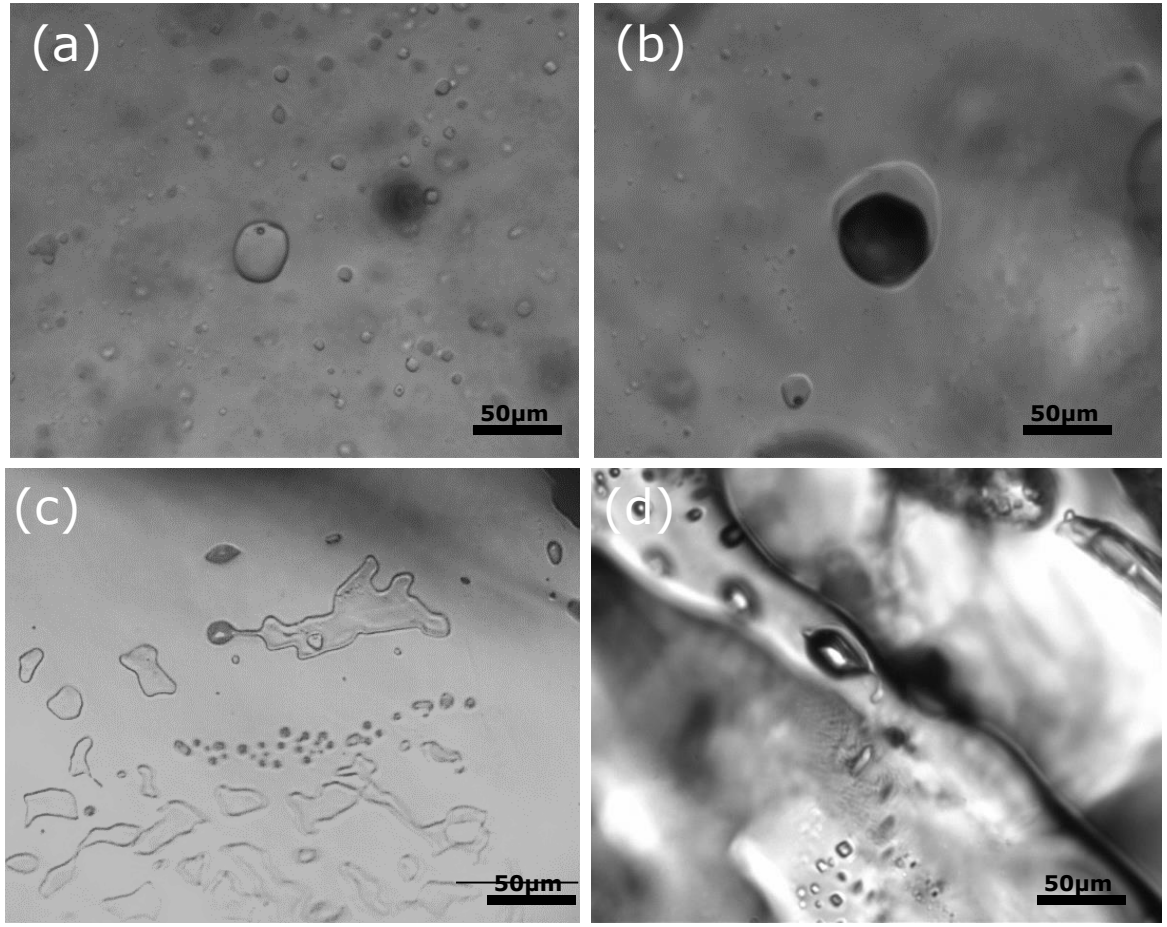
Investigation: combined microscopy and Laser Raman spectroscopy

Single phase fluid inclusions

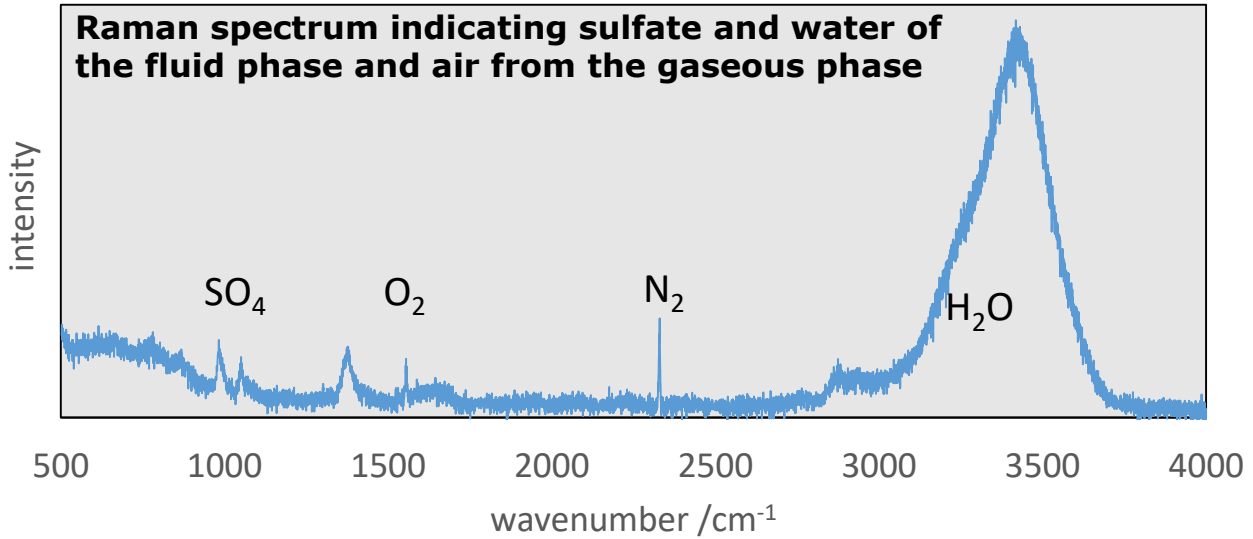


- most fluid inclusions are small sized and single-phased
- they occur in dense clouds, often along planes
- they exhibit often chevron structure
- small inclusions tend to have cubic shape and were formed during euhedral growth of the host crystals
- inclusions contain either (paleo) air or NaCl-saturated aqueous solution

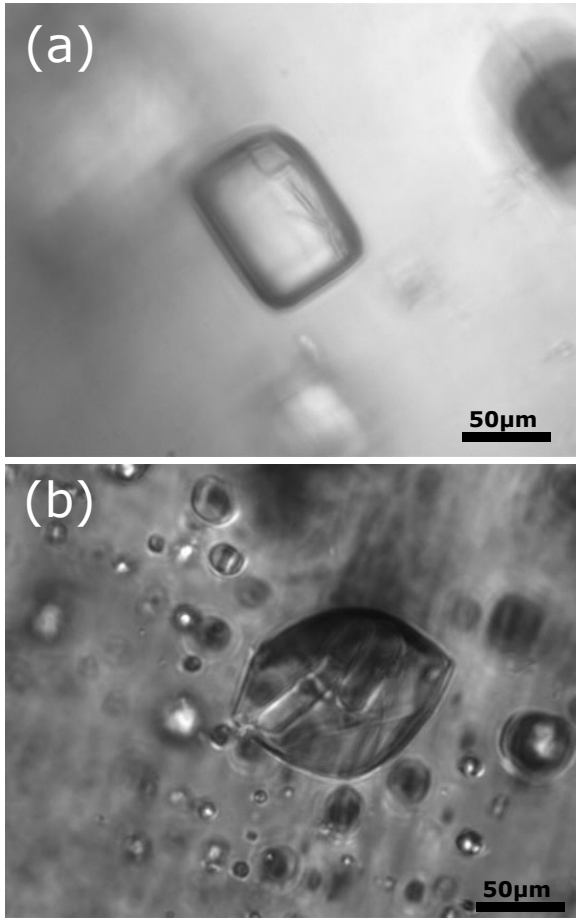
Two phase fluid inclusions



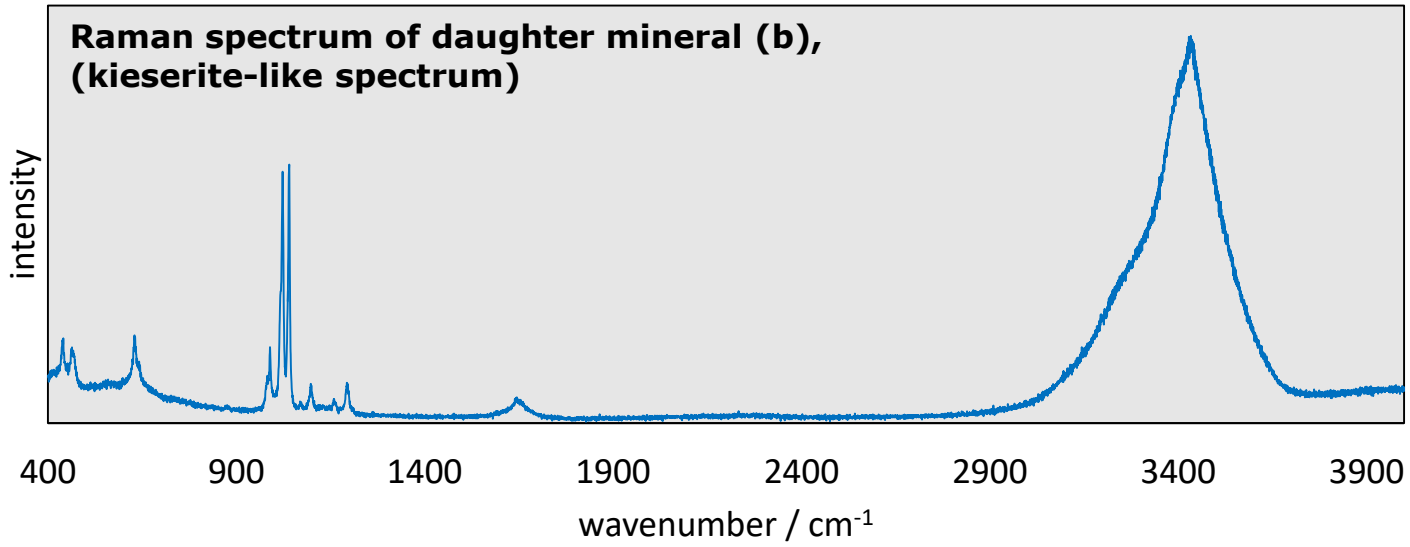
- observed with well-rounded or irregular shapes
- small shrinkage bubbles are found in some of the larger inclusions and might representing volume reduction of the fluid on cooling (a)
- secondary loss of fluid by leakage, causes bubble-fluid ratio to increase (b)
- the visco-plastic behavior of salt promote necking down (c) and leakage (d) of fluid inclusions and cause the formation of irregular forms



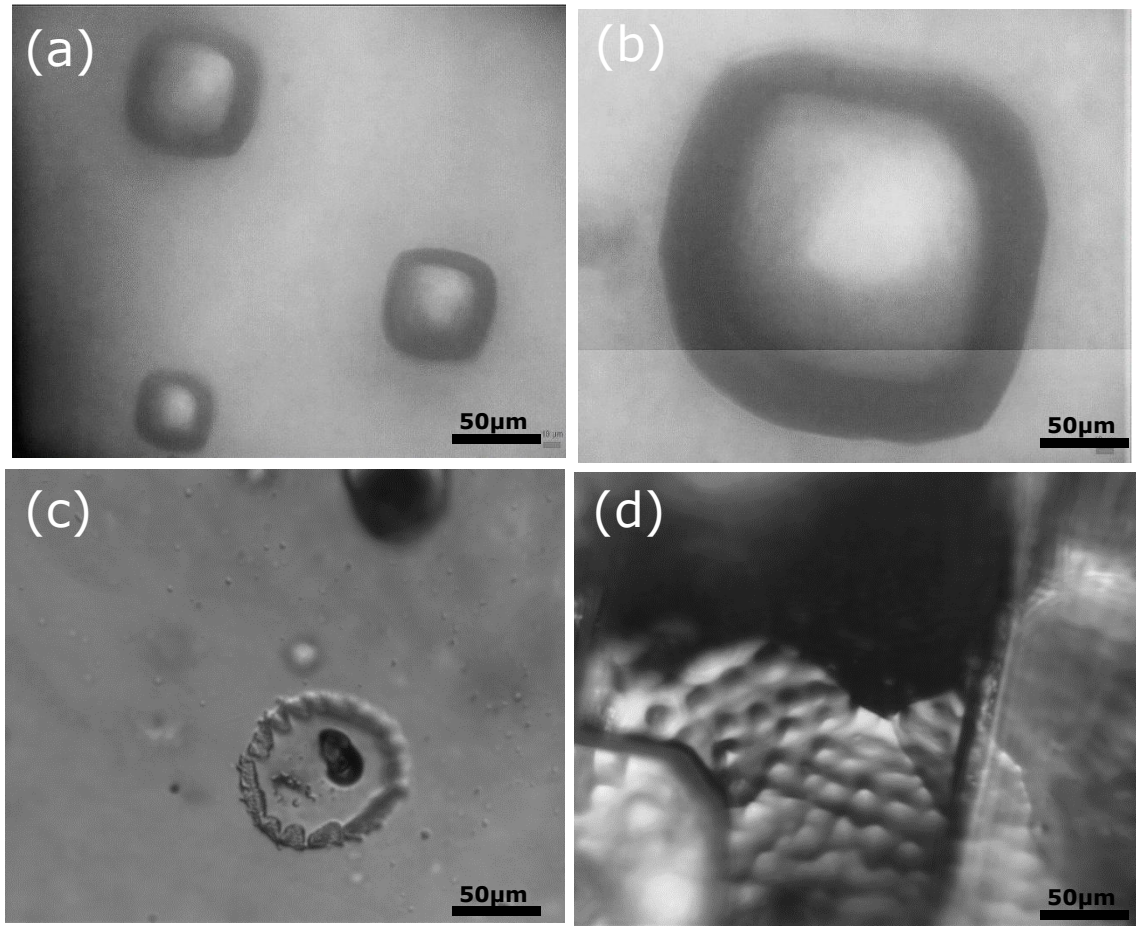
Fluid inclusions with daughter minerals



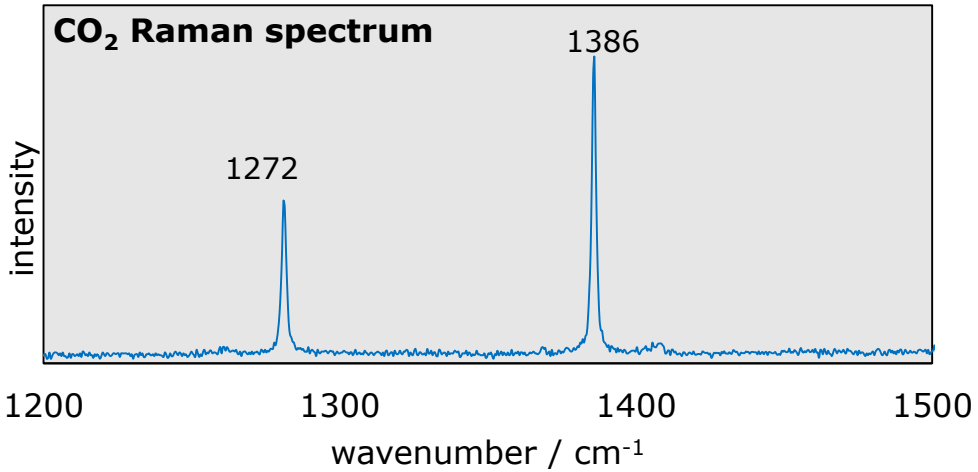
- daughter minerals = crystals that have formed from the fluid after trapping in the inclusion
- some dispay euhedral shape (a), most are irregular shaped (b)
- frequently found in salt beds associated with potash deposits with high concentration of K and Mg in the brines



Fluid inclusions in “popping salt” (strongly gas-bearing salt rocks)



- the host rock sample originate from a distinct area near a basaltoide dike intrusion
- isolated pressurized CO_2-rich inclusions (a,b) witin single salt crystals
- often very large (b)
- they set the host under considerable stress and decrepitation structures were found (c,d)



Summary and Conclusion

Fluid inclusion are numerous and best to observe in clear halite and sylvite minerals.

Although the CO_2 concentration in whole rock samples is high, fluid inclusions are predominantly free of CO_2. They contain (paleo) air and brine, occasionally daughter minerals occur.

This suggests, that secondary intruded gas, such as volcanic CO_2, is mainly bond along grain boundaries as well as in fractures and microcracks.

Only in distinct areas where salt deposits encounter volcanic basaltoide intrusion, CO_2-dominant inclusions occur in so-called "popping salt".