New insights on gypsum twinned crystals

mineralogical implications for natural gypsum deposits

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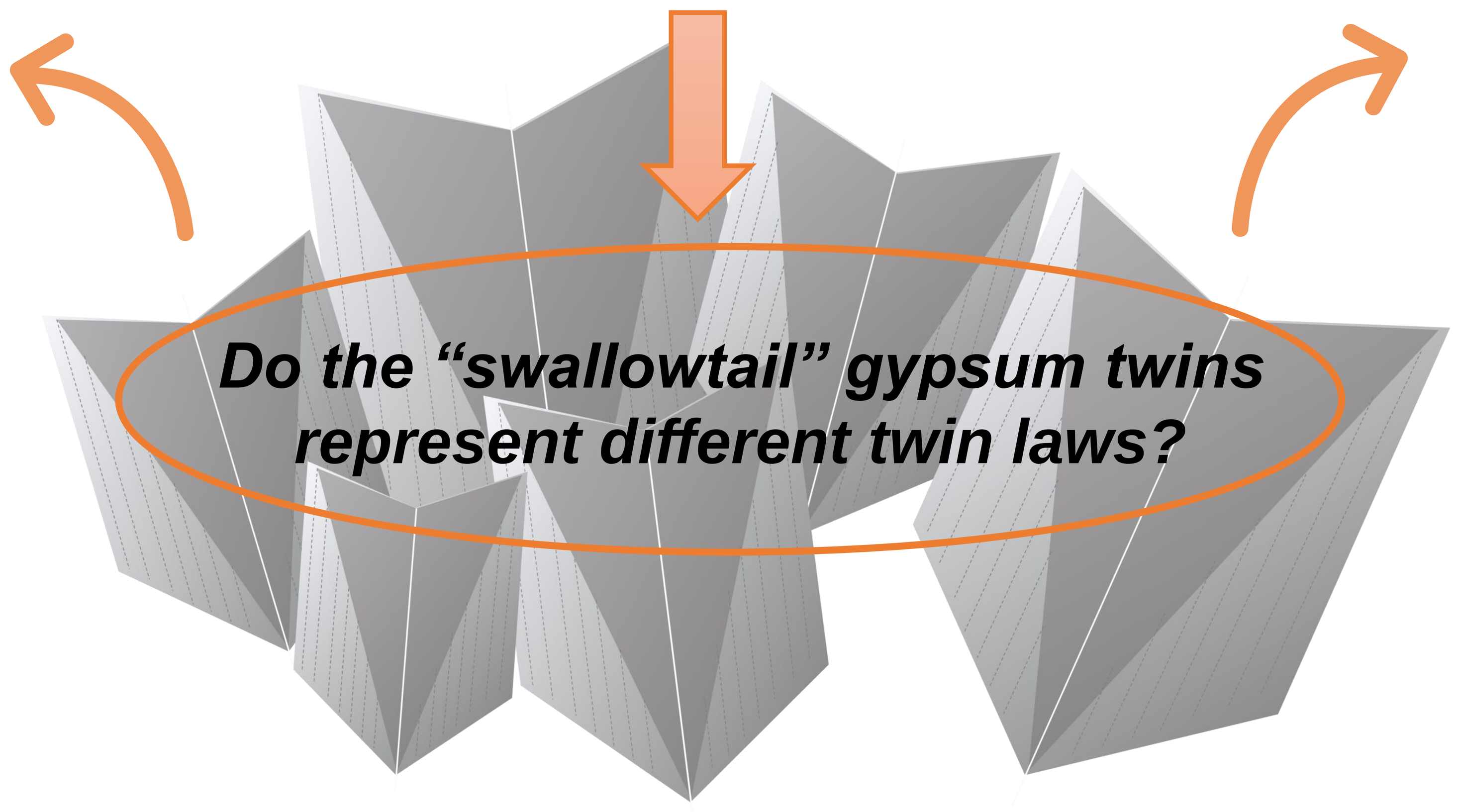
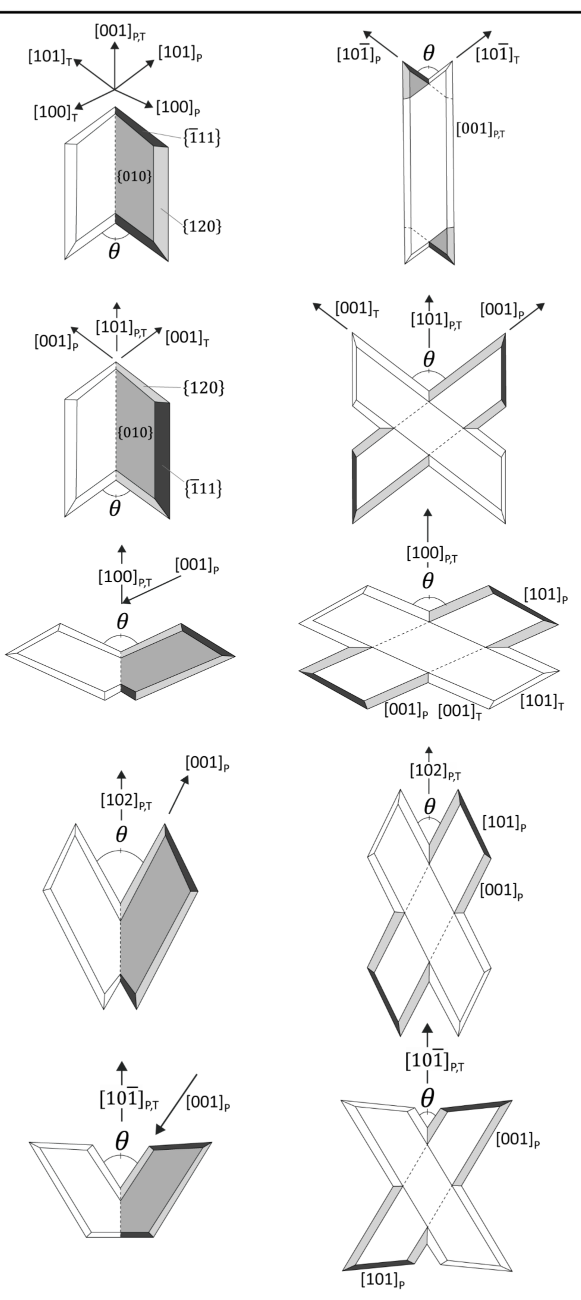
Background information. Gypsum twins are often defined as "swallowtail twins", which is the terminology usually used to identify gypsum twinned crystals with a shape at a first glance similar.



1. The five twin laws of gypsum. The re-entrant angle value (θ) and extinction angle between the crystals composing the twin (Δ) are useful tools to distinguish among the five twin laws.

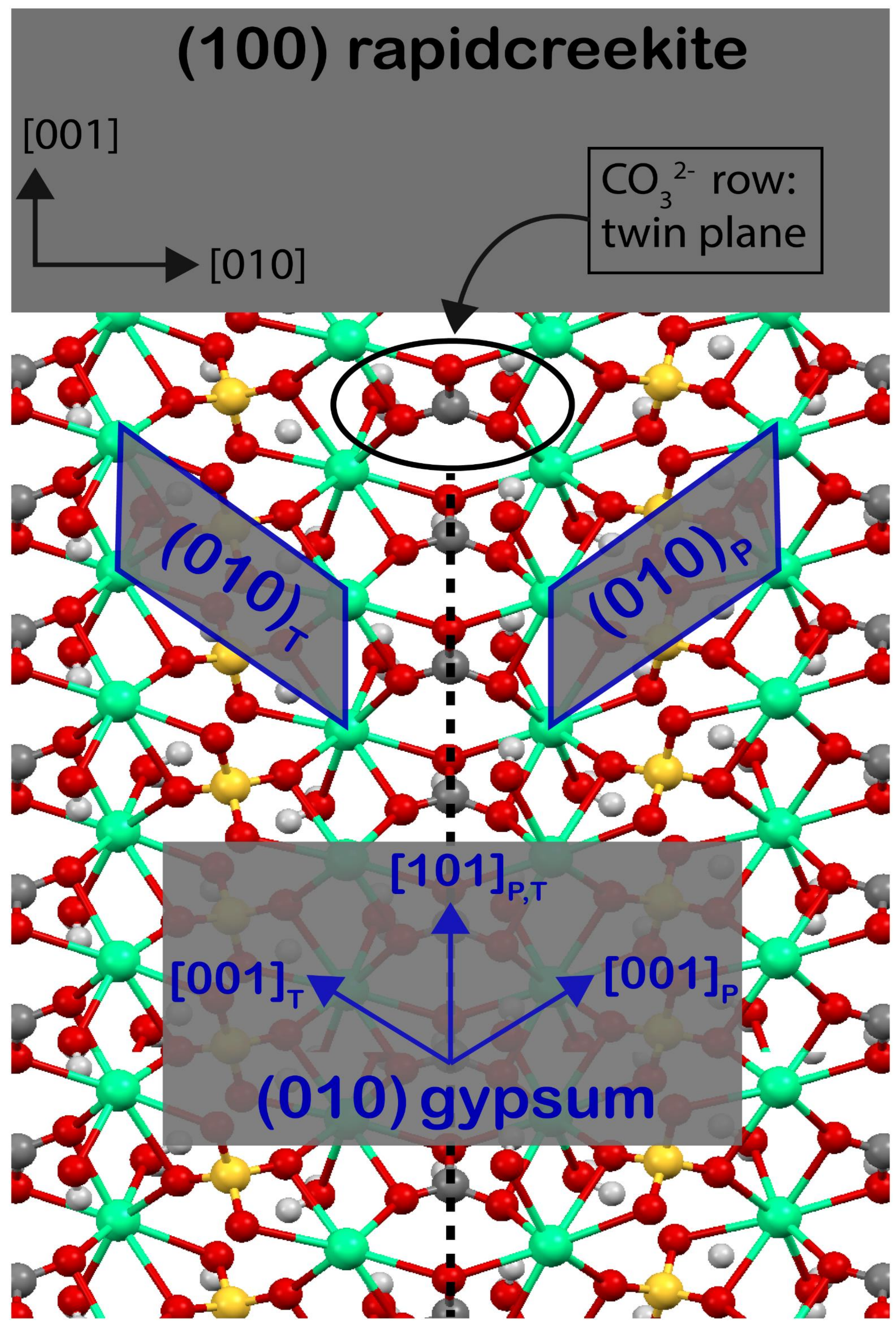


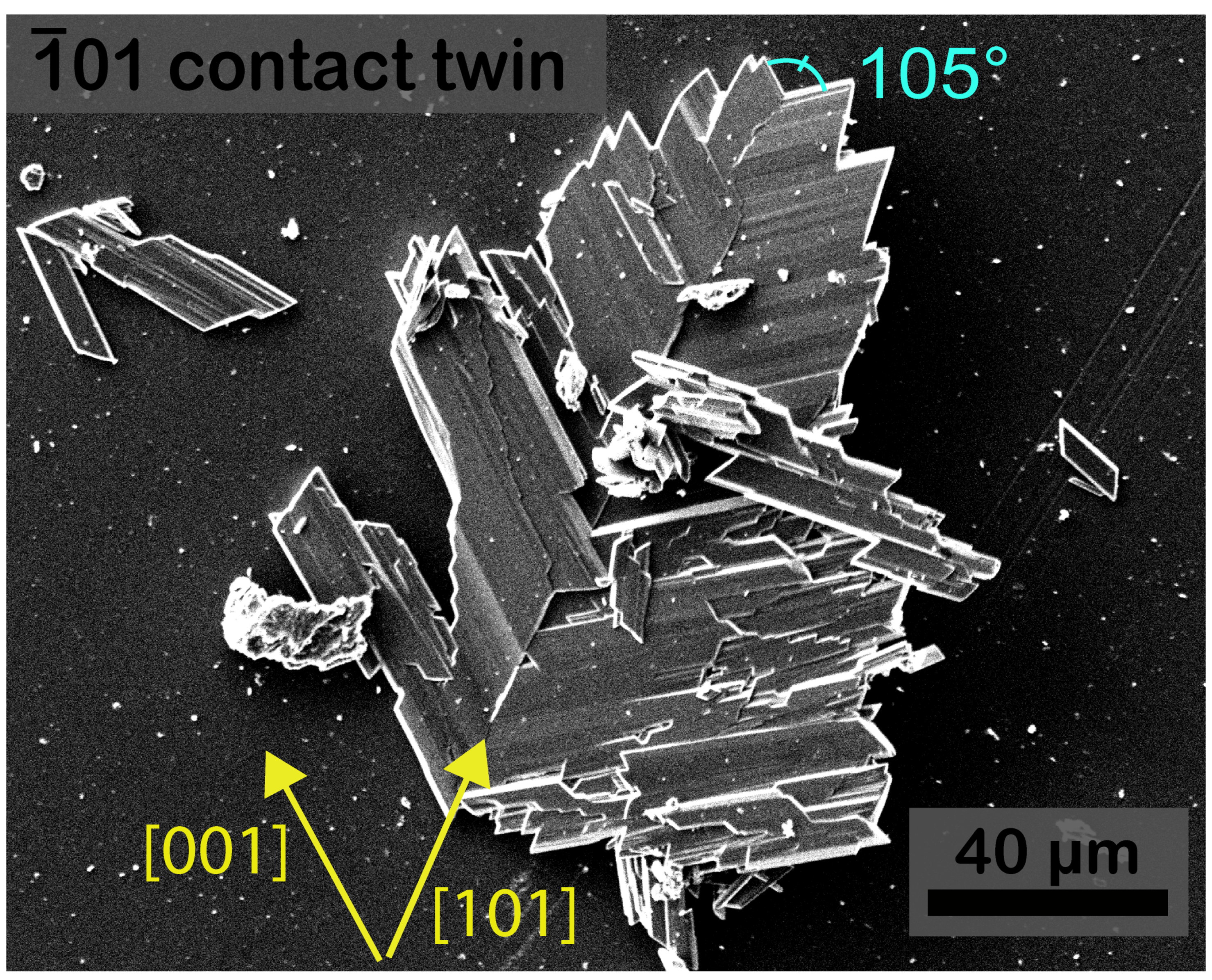
TWIN LAWS	CONTACT TWINS	PENETRATION TWINS	θ	Δ
100			105°	14°
$\bar{1}01$			105°	26°
001			132°	27°
$20\bar{1}$			53°	24°
101			62°	43°

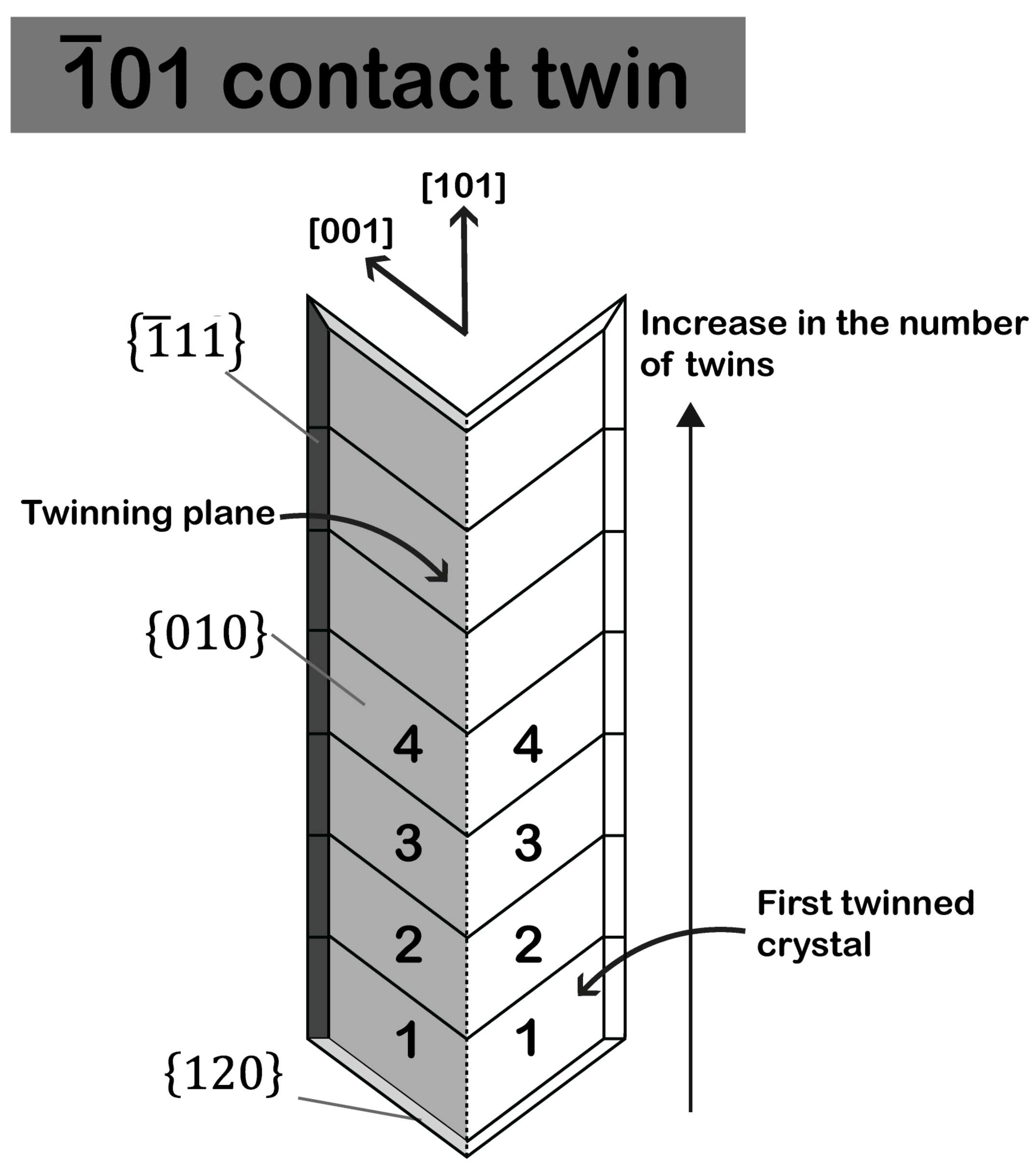
Experimental design. We investigated the effect of calcium carbonate ($CaCO_3$) on gypsum habit by performing temperature-controlled laboratory experiments, starting from solutions saturated in $CaSO_4 \cdot 2H_2O$ with and without adding carbonate ions.

Results. The precipitation of twinned gypsum crystals has been experimentally obtained ($\bar{1}01$ contact twin law) by adding carbonate to the solution.

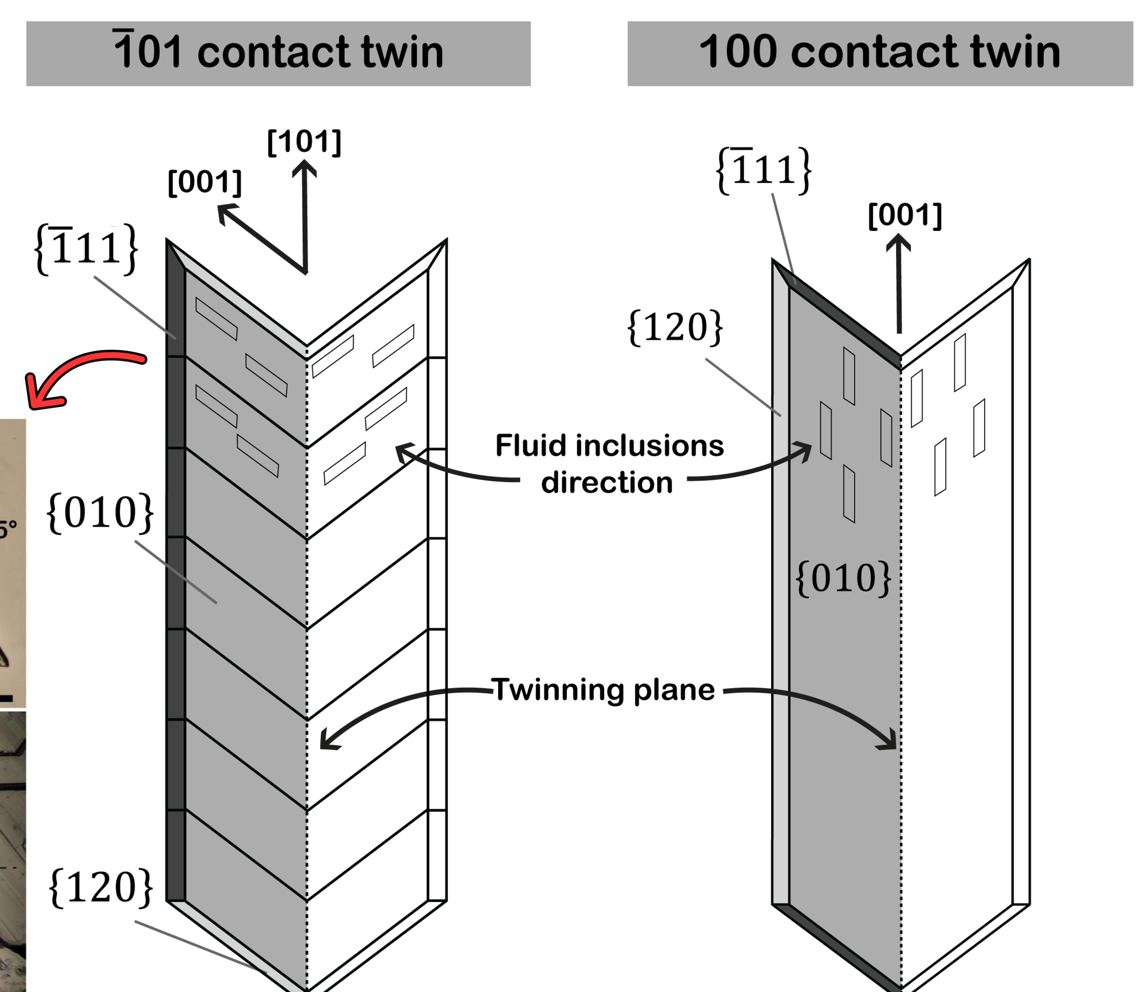
2. Can impurities trigger different twin laws? An epitaxial relationship between rapidcreekite ($Ca_2SO_4CO_3 \cdot 4H2O$) and gypsum structure ($CaSO_4 \cdot 2H_2O$) may promote the formation of $\bar{1}01$ gypsum contact twins.



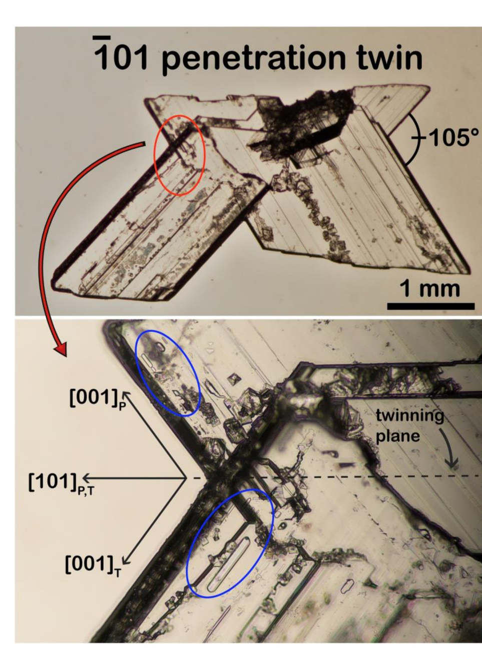


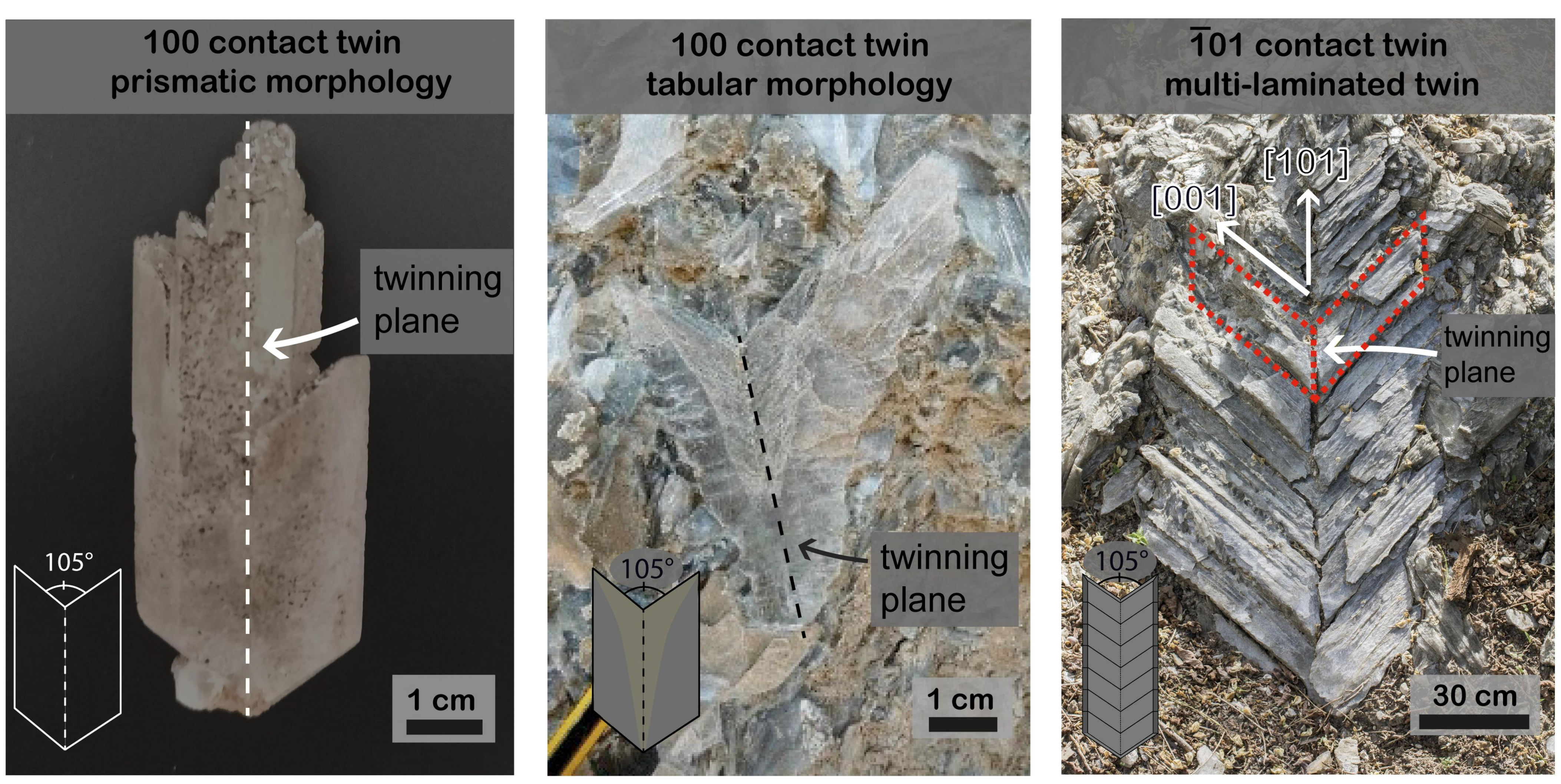


Implications. The orientations of primary fluid inclusions (of the negative crystal-shaped) with respect to the twin plane, and the main elongation of sub-crystals making the twin, are a fast and useful tools to distinguish between the 100 and $\bar{1}01$ twin laws.



Implications. The high carbonate content in brine from which evaporites precipitated could have promoted the formation of the $\bar{1}01$ gypsum contact twins.





Take-home message

Different gypsum twin laws and habits can be observed in nature, triggered by a wide array of impurities which are present in their depositional environments and may exert a critical role in the selection of the twin law.

Hence, identifying the impurities able to promote the selection of specific twin laws could have relevant implications for the geological studies aimed at interpreting the gypsum depositional environments in ancient deposits.

References. Cotellucci, A., et al. $\bar{1}01$ contact twins in gypsum experimentally obtained from calcium carbonate enriched solutions: mineralogical implications for natural gypsum deposits. J. Appl. Cryst. 2023; 56 (3):603-610.