# THE RIDDLE OF PAPER SPAR

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**Author's specimens and photos**

Calcite is one of the most wide-spread mineral species and, at the same time, the Mineral Kingdom's champion in habit multiplicity. The morphological fertility of calcite results from its polygenicity: calcite is stable at a wide range of physicochemical conditions, and that is why it occurs in such a wide variety of geological environments. As the latter alters, a growing calcite crystal just changes its habit accordingly – and keeps on growing.

Among the innumerable natural habits of calcite, paper spar can be described as *"A crystallized variety of calcite occurring in thin lamellae or paperlike plates"* (Glossary of Geology, 1997).

In such a thin tabular crystal (Fig. 1), the predominant pinacoid c combines with narrow lateral faces belonging to the main rhombohedron or hexagonal prism *m* (Fig. 2a). With a certain combination of external conditions (feeding environment's temperature, pressure, and composition), these lateral faces grow at an excessive rate (Fig. 2b); as a result, the plate width surpasses its thickness ten fold.


1. Thin tabular **calcite** crystal, 4 cm across. Dal'negorsk, Primorsky krai, Russia.


11. Curved **paper spar** groups, 8 cm.
Dal'negorsk, Primorsky krai, Russia.

area of oversaturation maximal gradient, normal growth is added as a tangential component (shown with arrows on the Fig. 8b) which is maximal at the base of the ledge and minimal at its front. Due to this difference, the growing pinacoid faces are slow transforming into slightly expressive surfaces bearing growth figures in the form of small shallow knobbles. Eventually, both sides of this "pinacoid" interlock into a blade with a ragged edge instead of a narrow facet of lateral faces (Fig. 9). This theoretical picture can be seen on the specimens shown on Figs. 2 and 3.

When no previous generation calcite is available in a specimen but only paper spar groups are seen, a strange impression arises as if the groups have appeared from naught. In this case, an obligate recrystallization of the first calcite generation should have taken place, which produced a habit change with pinacoidal as the more preferable with the external conditions there. The distribution of matter within an array of small individuals instead of a single larger crystal of the same habit is evidence of multiple parallel growth fronts crystallizing. In its turn, the latter shows a lag between mass transfer and adsorption rate, which provoked a dendritic type (Kantor, 2006) for recrystallization. That is why the recrystallization groups are more typical in the diffusion feeding mode.

A special case is the emergence of a curved paper spar pack (Fig. 11). The curved-faced calcite crystals seen here contain a considerable quantity of isomorphic manganese (Kantor, 2009). Naturally, their recrystallization might be accompanied by a composition refinement.

Lastly, the overgrowth of a paper spar group as second generation calcite may proceed together with recrystallization of the previous generation into a united body of a paper spar group.

In summary: *solitary* paper spar crystals nucleate and grow at existing and constant conditions causing the pinacoid to be the dominating crystal form. If, however, the same conditions appear during ongoing crystal growth, paper spar *groups*, in essence one of calcite dendritic habits, may arise by recrystallization or overgrowing a second generation. In this case, groups of parallel-sided plates with straight edges (Fig. 10a) appear in a flowing solution whereas groups of plates with sharp and ragged edges (Fig. 10b) appear in a stagnant solution.

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## References

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