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Experimental Investigation of Lithium Partitioning among Plagioclase, Rhyolitic Melt, and H₂O Vapor

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Experimental determination of lithium partition coefficients between plagioclase, rhyolitic melt, and H₂O vapor

3

Li

6.94 g/mol

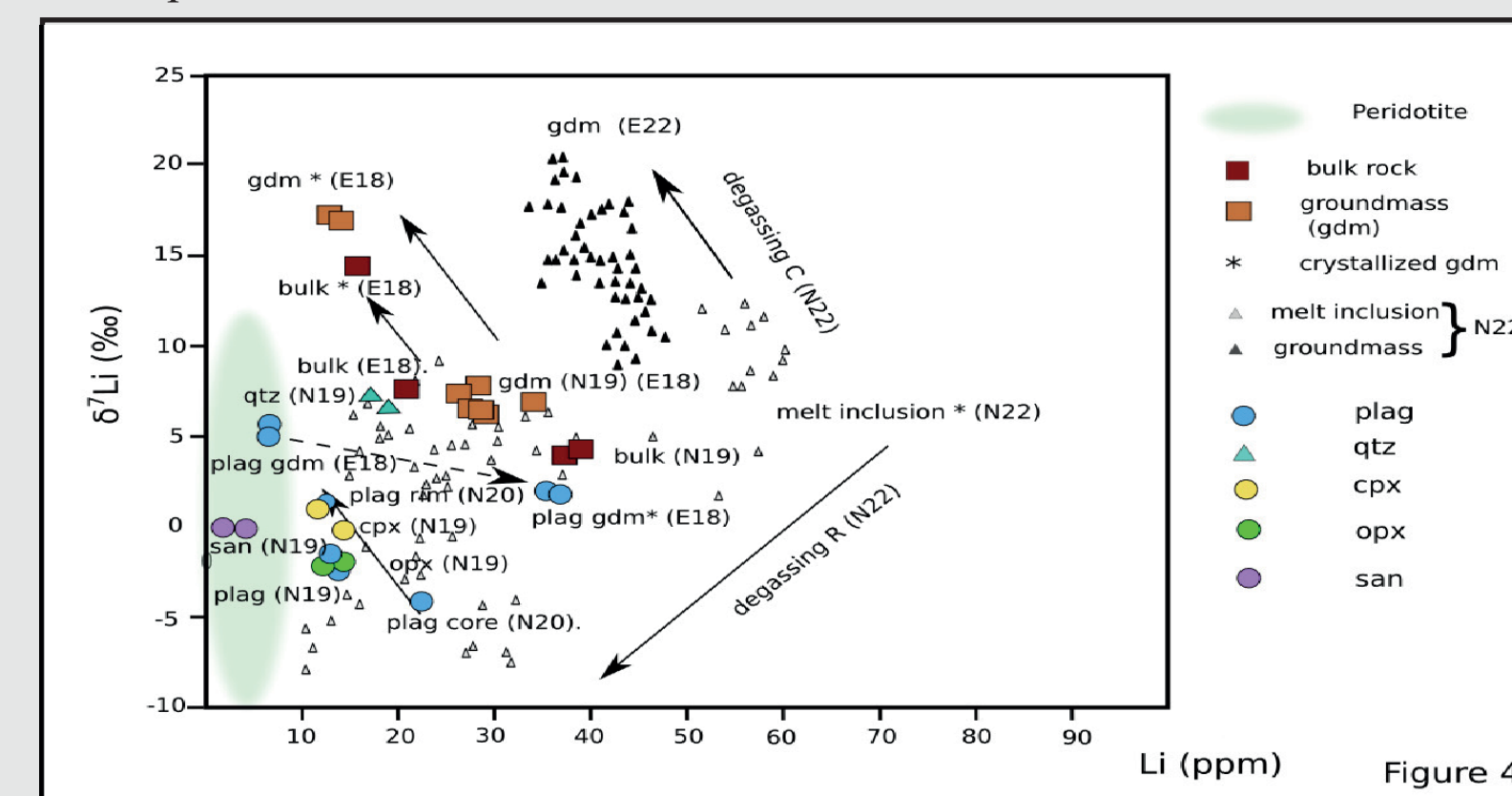
Volcanic products contain minerals and elements that open windows onto underground volcanic processes. Lithium is one of these trace elements. Lithium is a rare element on Earth, best known for its use in industry, healthcare, ceramics and battery applications. But what about its usefulness in volcanology?

In volcanology, the objective is to better understand volcanic hazards in space and time. So we're looking for tracers and chronometers that can better constrain volcanic processes.

Li abundance in volcanic rocks

Li is a rare element in the cosmos, but it is concentrated in certain rocks (pegmatites) and phases (brines). It is also hidden in magmatic rocks at low concentrations

From Dupont de Dinechin et al. 2023

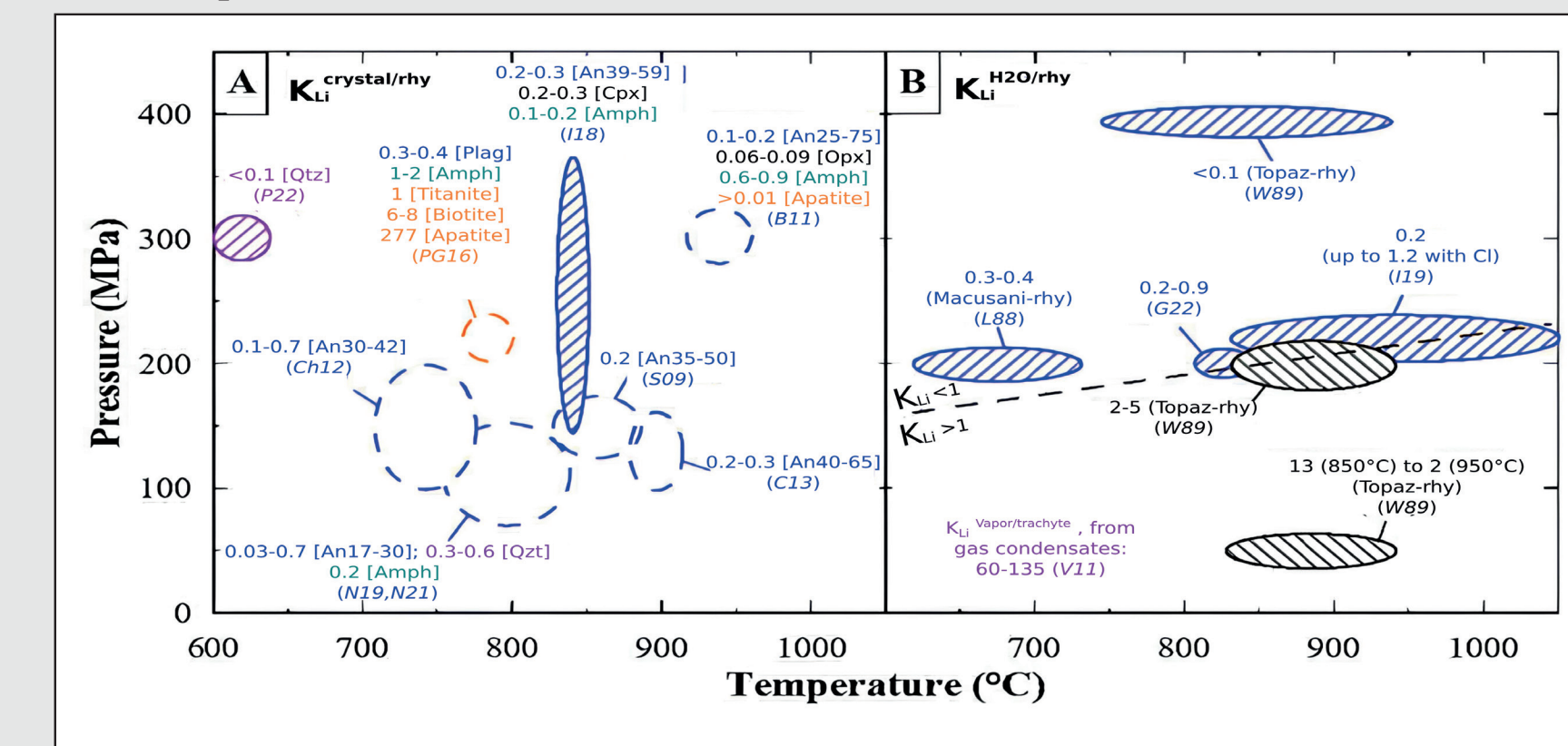


Li partition between phases

Partition coefficients were obtained over a wide range of temperatures and pressures.

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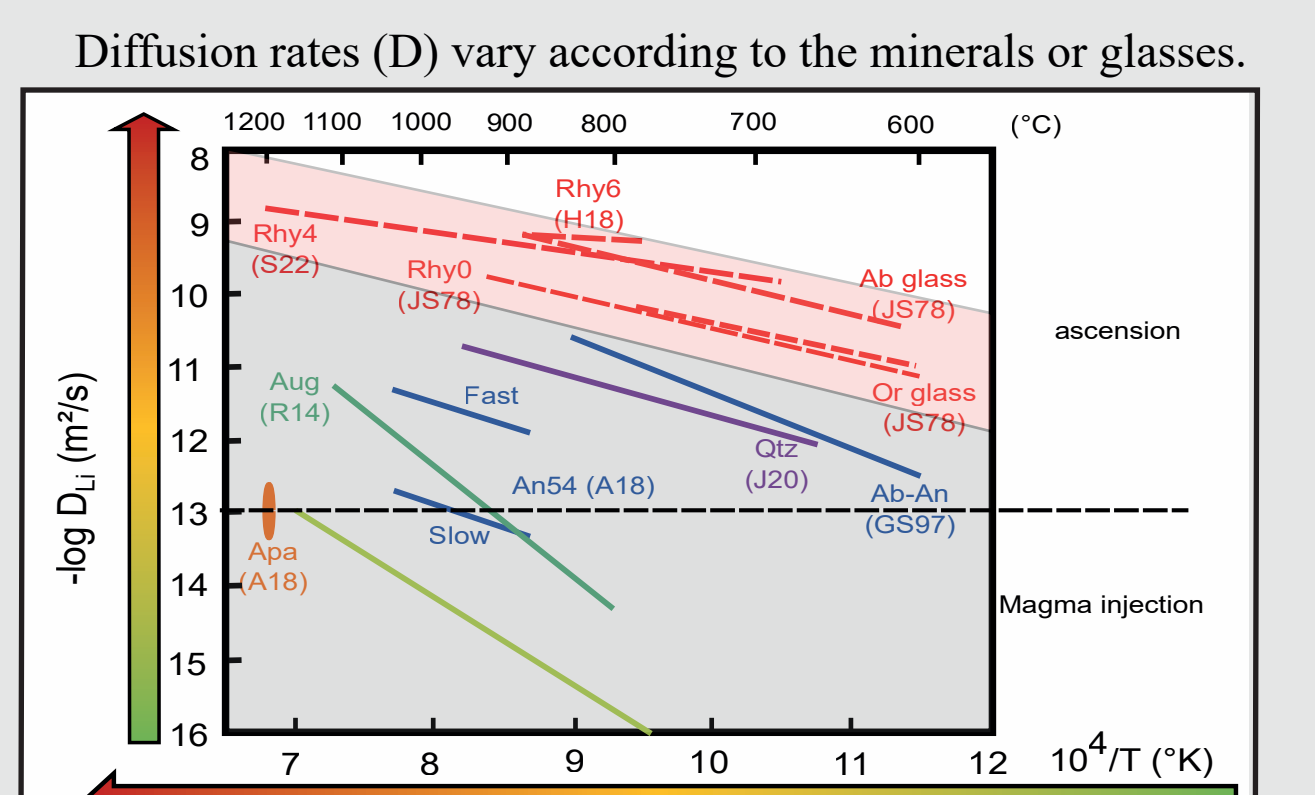
From Dupont de Dinechin et al. 2023



Li mobility

Intracrystalline diffusion is caused by a chemical gradient between zones of a crystal of different composition, witnessing variable growth conditions. This gradient balances with time via the diffusion of certain elements that serve as tracers to constrain the time of the magmatic process at the origin of this compositional gradient

Lithium is an element little but very mobile: a chronometer for rapid processes



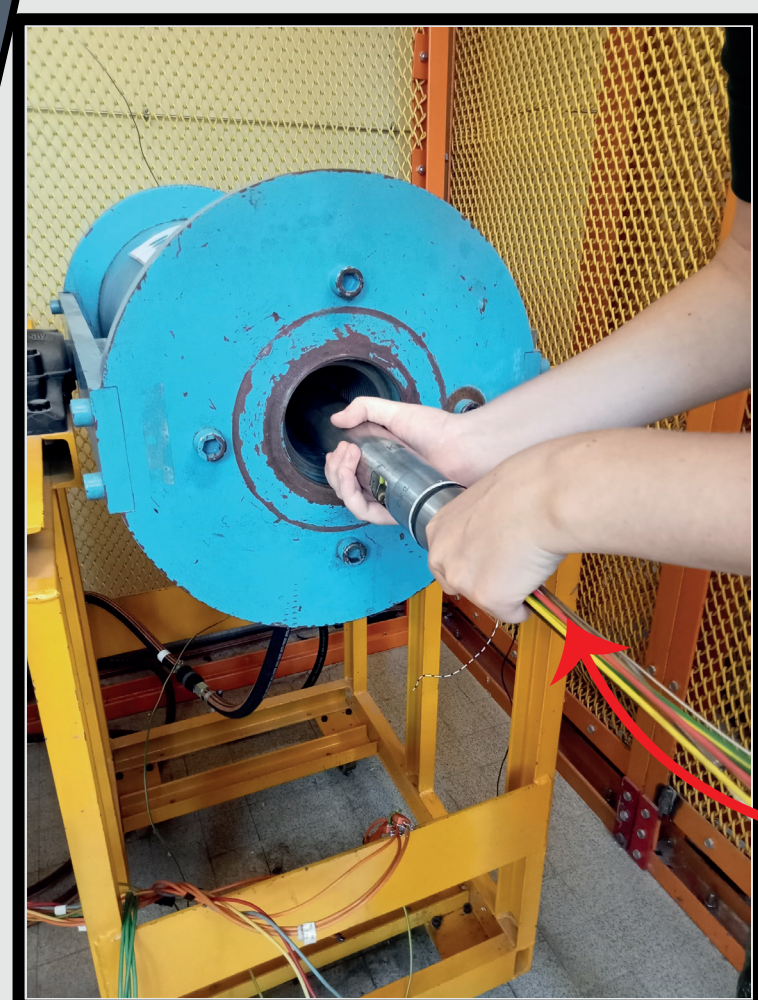
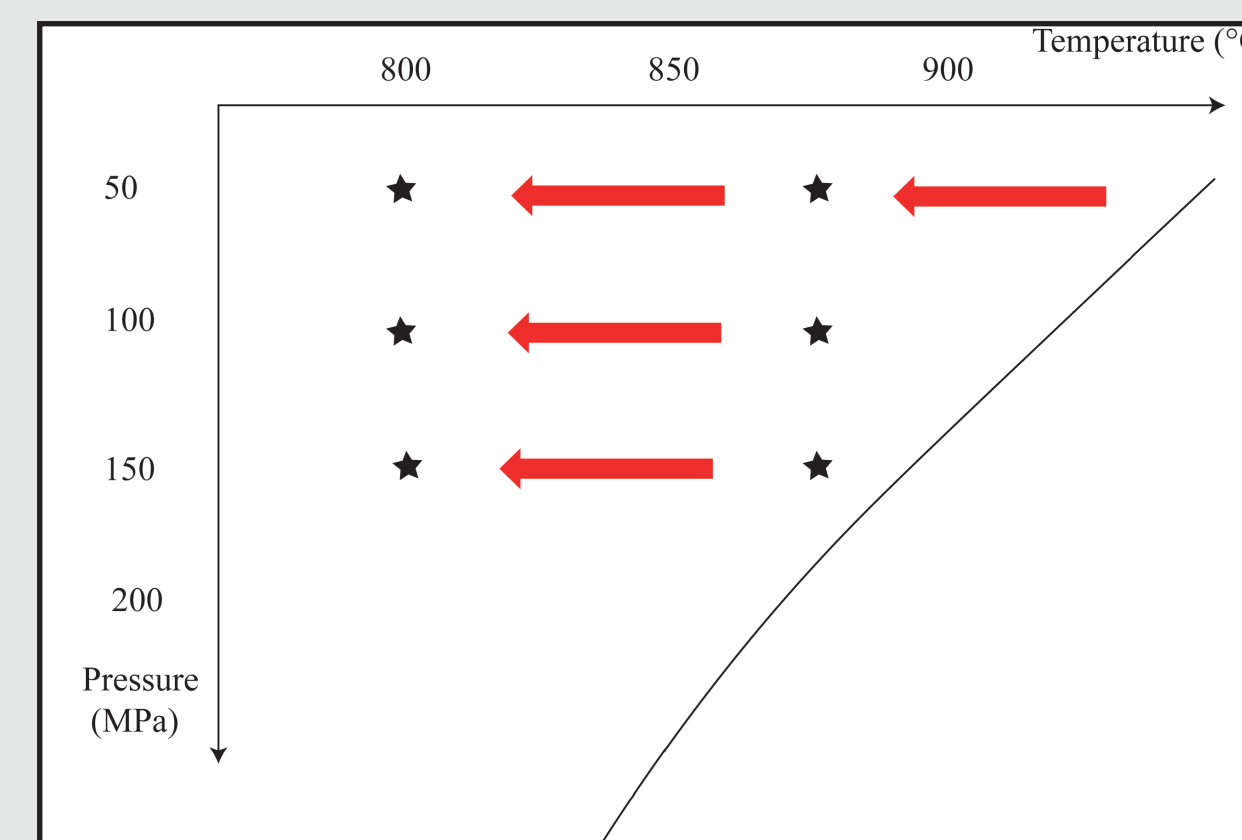
How does Li behave when magma rises?
How is lithium distributed during magma ascent between the liquid, mineral and gaseous phases?
How can we study it?

In situ crystallization experiments of plagioclase microlites

Experimental approach

Experiments about partition coefficients of Li between plagioclases, melt and fluid phase.

Method:
Nucleation and growth of microlites of plagioclases



Initial rhyolitic materials, water saturated and doped in Li (2000ppm, 1000ppm and 500ppm)

Conclusion

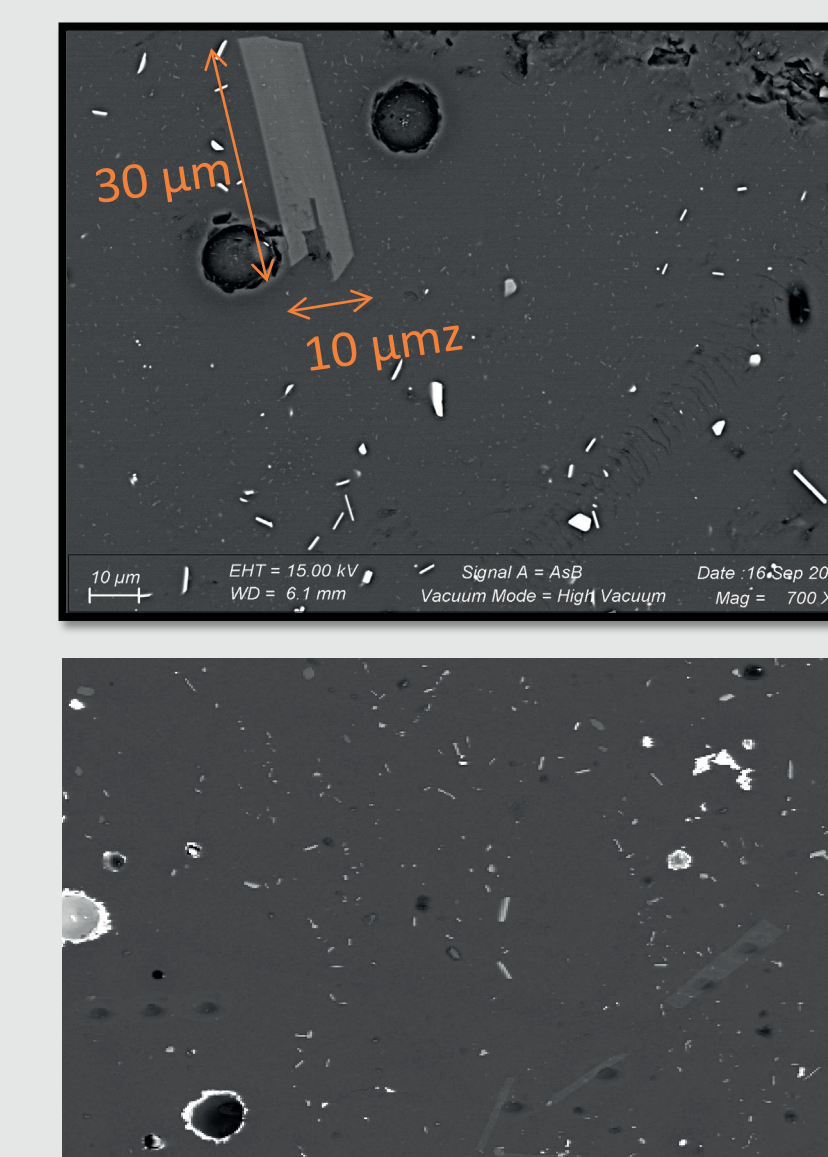
In situ crystallization experiments of plagioclase microlites give more informations about the distribution of Li in magmatic systems. These experiments provide a better understanding of Li's behavior under different conditions. We can observe which parameters influence Li and what effect it has on the system.

Li is small but powerfull.

As the third element on the periodic table, lithium's characteristics make it an interesting elements to study, helping us to better understand pre, syn-eruptive processes (ascent rate, degassing).

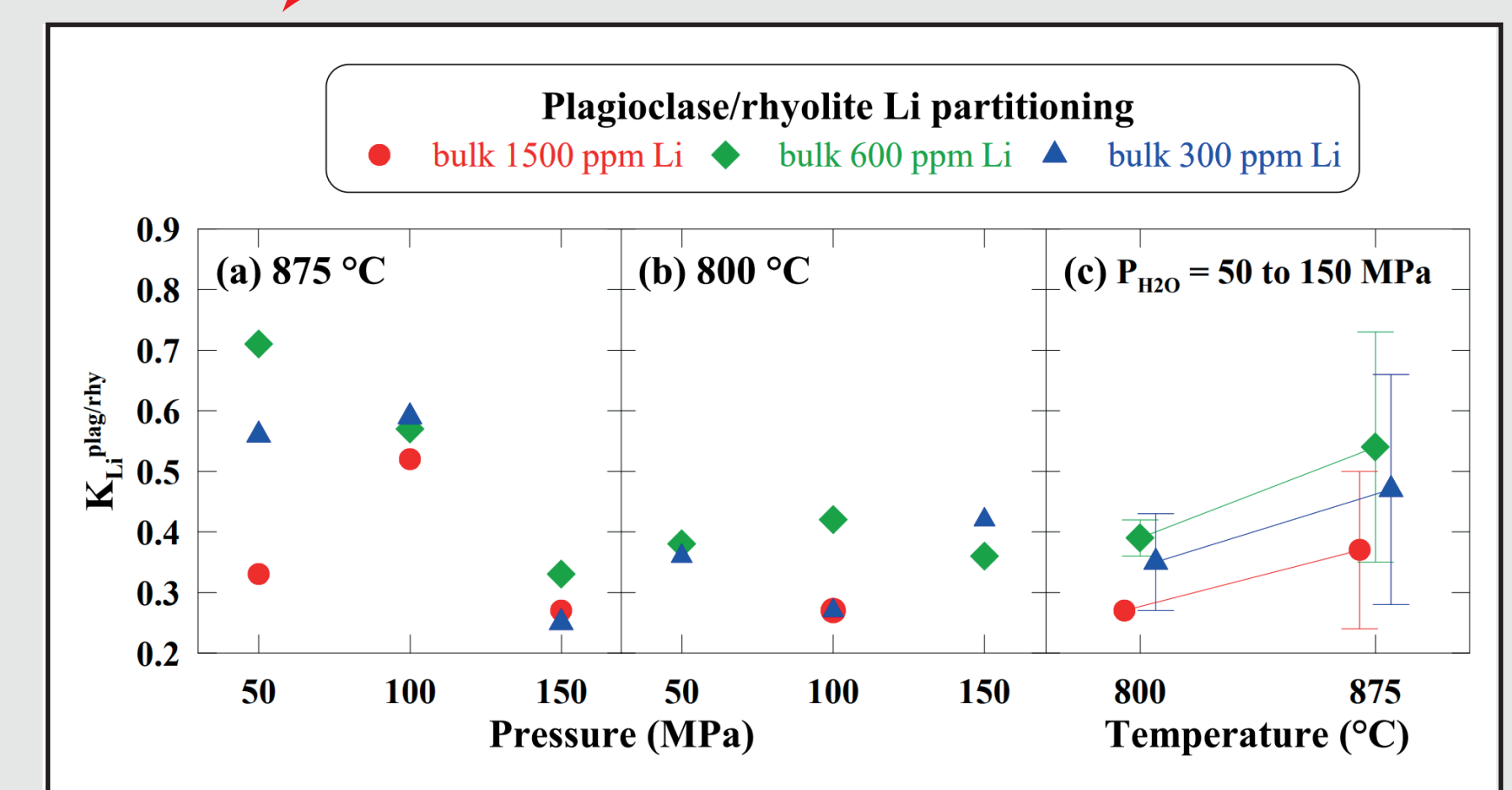
Work in progress

From Dupont de Dinechin et al. (in progress)

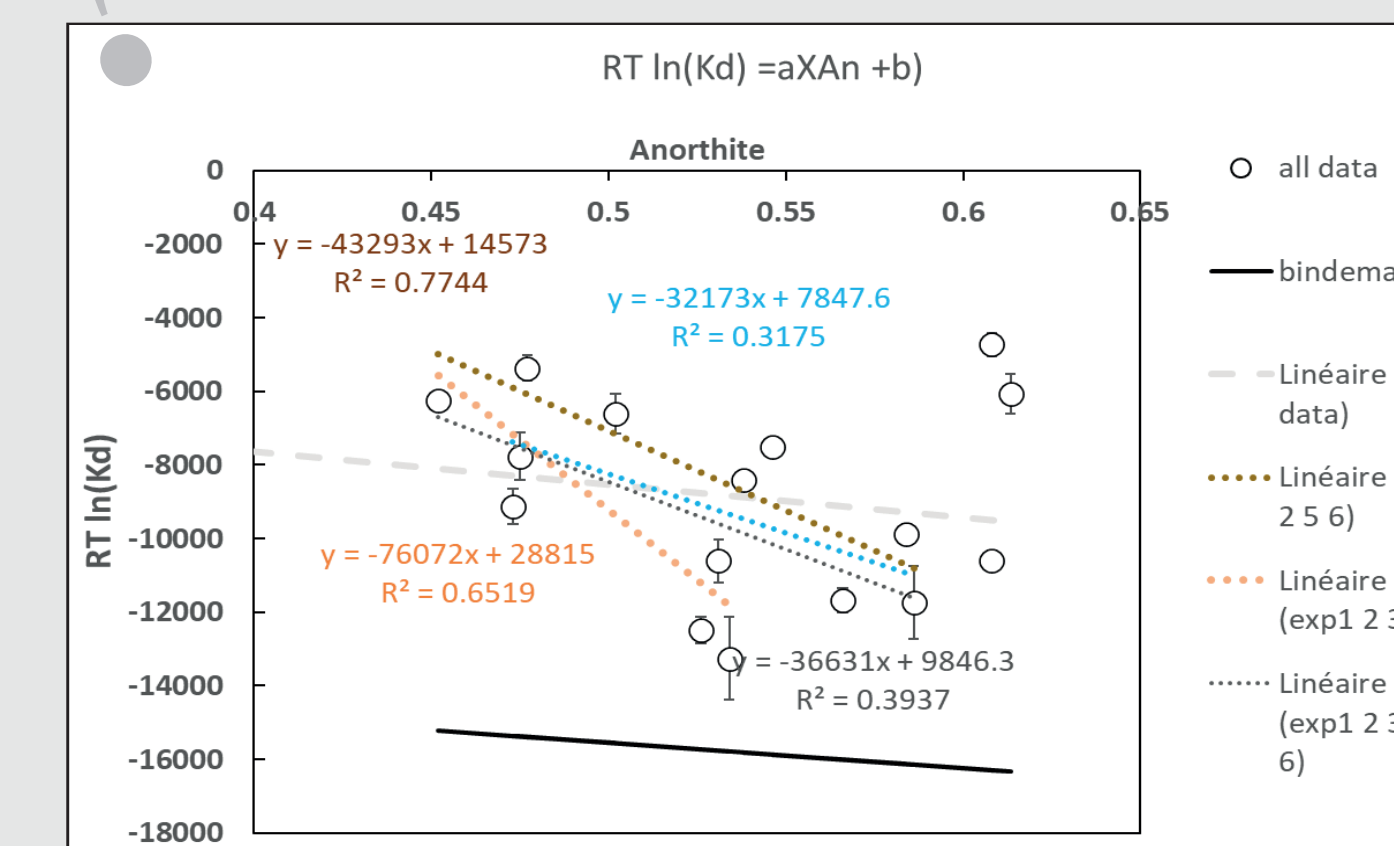


Analyses SIMS CRPG

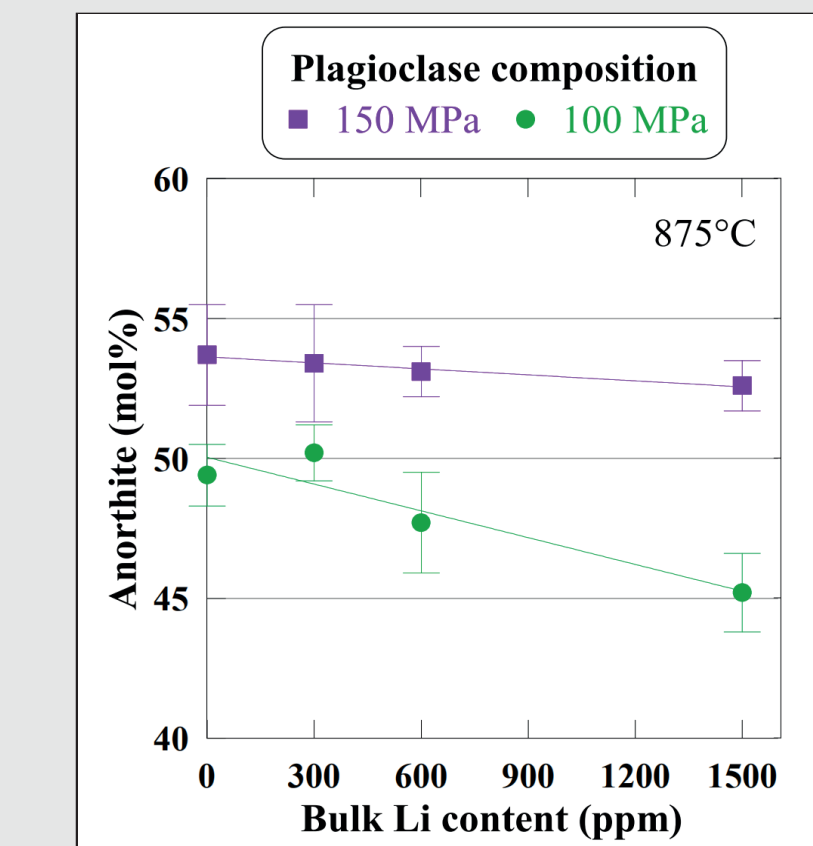
Calcul of kd by [Li]iplg / [Li]glass by method of Monte-Carlo



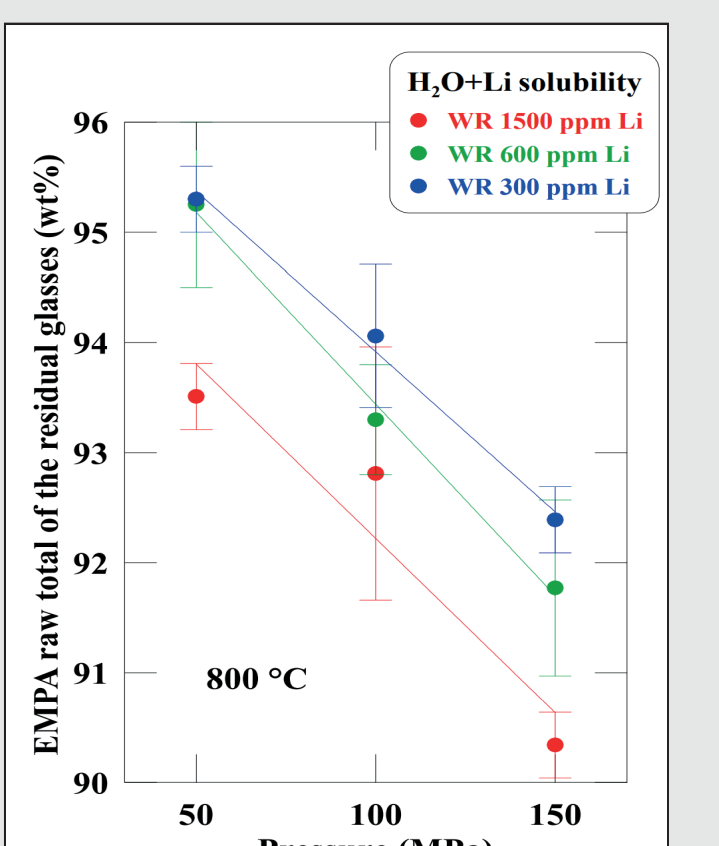
Kd dependent of An ?



Effect on An content ?



Effect on solubility ?



Futur work

Continue work on Li partition coefficients by making the system more complex: system with brine. Integrate ab initio calculation to study the integration of Li in a crystalline mesh. Better constrain its use in volcanology by verifying what Li more precisely time

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