

November 8, 2005

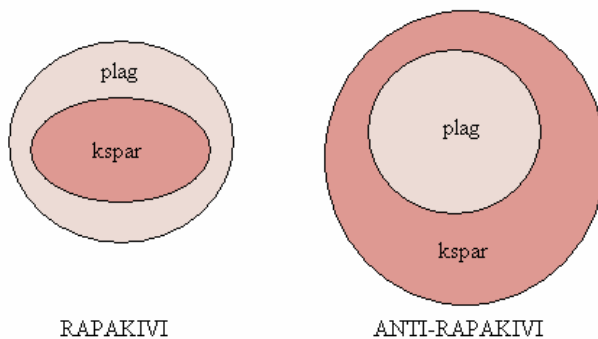
## Granites Continued, Rapakivi Texture

Bowen's argument: granites are produced solely by fractional crystallization because they all plot near the ternary minimum of qtz, plag, and kspar in composition

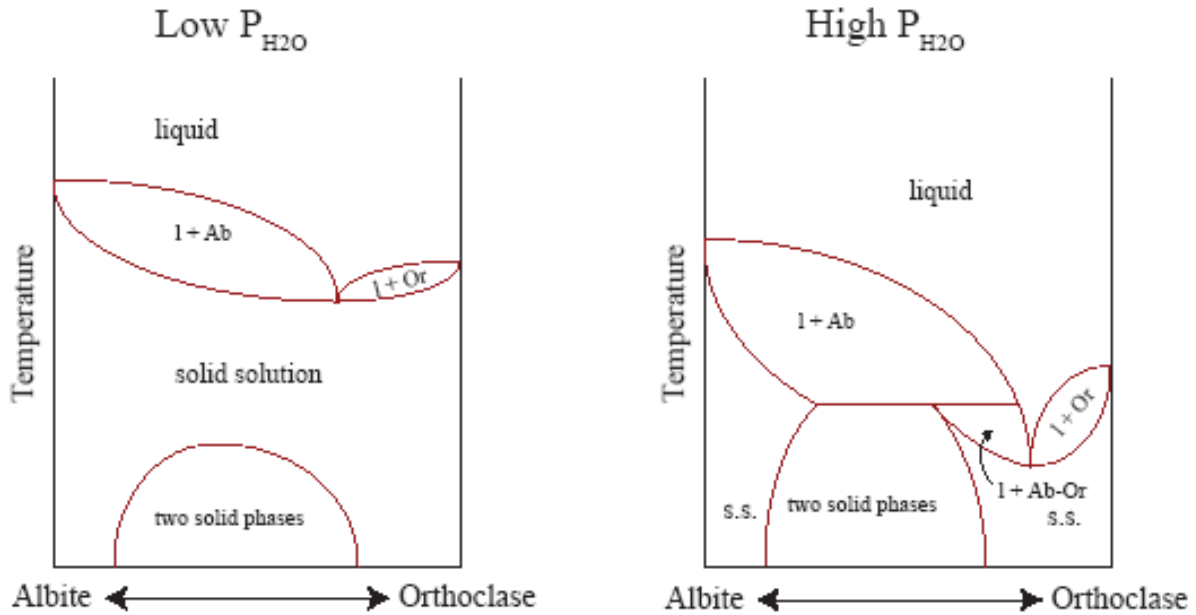
Problem: this system becomes eutectic-like if pressure  $P_{H_2O}$  increases or if Ca added to mixture in anorthite,  $CaAl_2Si_2O_8 \rightarrow$  therefore, you can ALSO make granite by partial melting, since the 1<sup>st</sup> melt will be at the eutectic composition no matter what the composition is

In a system with a ternary minimum, the first melt is variable. In a system with a eutectic, the first melt is at the eutectic. The last material produced by fractional crystallization has a composition near the minimum or the eutectic, depending on the system.

Bowen was right that fractional crystallization can create granite from a mafic parent magma (basalt). He was wrong that this was the only possible mechanism. The proof is rapakivi texture.



Rapakivi texture has kspar crystals ringed with plagioclase. Anti-rapakivi texture has plagioclase crystals ringed with kspar. Overgrowth textures such as these are evidence of fractional crystallization and a record the order by which the mineral components reached the solidus. In the system Ab-Kspar-An-Qtz-H<sub>2</sub>O (Ab and An are both types of white plagioclase), we can clearly show that anti-rapakivi texture can be achieved by fractional crystallization. It is, however, impossible to crystallize kspar followed by plagioclase, rapakivi texture, by fractional crystallization.



To make rapakivi:

Take liquid A in equilibrium with plagioclase and kspar solid phases. Decompress. Now A is in the plag primary phase volume, so plag crystallizes to return the liquid to equilibrium. This forms plag rims on all the crystals, including kspar.

Q. How would we decompress our magma suddenly?

A. Huge silicic eruptive events – ash flow welded tuffs, as in the San Juans mountains (a 6000 cubic km eruption) and at Yellowstone (3 eruptions in 2.4 million years, 2 of them > 1000 cubic km eruptions). The magma bursts open the cap of the volcano, which then sinks to make a caldera. An eruption such as this catastrophically decompresses the magma. Rapakivi textures may record large volume catastrophic decompressions of silicic magma!

Layered intrusions – mafic – source of platinum for mining – appear preserved in crust  
 The big ones are from the Proterozoic and the Archean, such as the 2.05 billion year old Bushveld. >90% of the Pt in the world comes from one layer of the Bushveld that extends for hundreds of km in South Africa.