

Solubility of albite or jadeite + quartz + paragonite in H₂O at 600°C and 10-22 kbar

A. WOHLERS^{1*}, C.E. MANNING² AND A.B. THOMPSON¹

¹Institute of Mineralogy and Petrography, ETH Zurich, 8092 Zurich, Switzerland.

(*correspondence: Anke.Wohlens@erdw.ethz.ch)

²Department of Earth and Space Sciences, Univ. California, Los Angeles, CA, 90095, USA.

Fluids released at the blueschist-eclogite transition are predicted to be highly concentrated and capable of major mass transfer [1,2]. To explore this hypothesis, we determined the solubility of albite (Ab) or jadeite (Jd) with paragonite (Pg) and quartz (Qz) in H₂O at 600°C, 10 to 22 kbar. Natural, high-purity Ab+Qz or Jd+Qz were equilibrated with H₂O and NaSi₃O_{6.5} (NS3) glass by hydrothermal piston-cylinder methods [3, 4]. Fluid compositions were determined by crystal weight loss. Ab+Qz and Jd+Qz dissolve incongruently in H₂O, leaving residual Pg. NS3 was added in successive runs until no Pg was observed, giving fluid composition in equilibrium with both assemblages. Molar Na/Al and Na/Si increase from 10 to 22 kbar (1.41-2.37 and 0.16-0.21, respectively), indicating Na- and Si-rich fluids. With increasing *P* from 10-15.5 kbar, bulk solubility of Ab+Pg+Qz rises from 5.9 to 11.5 wt%; i.e., bulk solubility roughly doubles as the Ab-Jd-Qz transition is approached. In contrast, the bulk solubility of Jd+Pg+Qz decreases from 12.1 to 9.2wt% as *P* is increased from 17.5 to 22 kbar. At all *P*, measured solubility is greater than predicted due to strong Si-Al-Na complexing via polymerization. The isothermal rise and then decline of solubility near the Ab-Jd-Qz transition could be due to a combination of (1) *P*-dependent change in coordination of Al in minerals, melt and fluid, and (2) changing proximity to the hydrothermal melting curve. Our results indicate that most Si, Al, and Na in aqueous slab fluids are held in solution as polymerized species, which in turn elevate solubilities of key trace elements, such as Ti and other HFSE [5, 6].

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 [4] Newton & Manning (2002) *Geochim. Cosmochim. Acta* **66** 4165-4176. [5] Manning *et al.* (2008) *Earth Planet. Sci. Lett.* **272** 730-737. [6] Antignano & Manning (2008) *Chem. Geol.* **255** 283-293.

Experimental constraints on protolith contributions to Sierra Nevada granitoids, California, USA

M.B. WOLF

Augustana College, Rock Island, IL 61201, USA
 (michaelwolf@augustana.edu)

Metamorphic and igneous rocks of the Sierra Nevada Mountains, CA, constitute deeper regions of continental crust from and through which subsequent granitoids of the batholith were derived and intruded. Four samples represent the most abundant country rocks and thus the most likely to have been involved in the generation of batholithic magmas. Magmatism occurred in two distinct episodes indicating variations in mantle vs. crustal input as a function of longitude and time.

Thirty-three piston-cylinder experiments were conducted at 10 kbar, 800-1000°C, wet & dry, for 24-166 hours to determine whether different proportions of the assumed crustal protoliths could generate the range of granitoid magmas seen in the Sierras. The partial melts produced from these mixtures have a wide compositional range: SiO₂ from 49 to 74; Al₂O₃ from 11.5 to 18; FeO from 0.8 to 11.4; MgO from 0.6 to 3.7; CaO from 1.2 to 7.8; Na₂O from 1.5 to 4; K₂O from 0.6 to 2.9 wt.%. Melts that were generated were predominantly tonalitic and granodioritic, with only one clearly granitic composition. A presumed east-west difference in country rock composition resulted in a wide range of overlapping melt compositions; two of the six most silicic/alkalic melts were derived from sources rich in mafic metavolcanics, while two of the top three had no schist input.

Protolith fertility plots (melt fraction vs. temp.) show variable trends; some mixtures are divergent (same MF at low T, different MF at high T), some are convergent (different MF at low T, same MF at high T), some are shallowly sloped (large changes in MF with increasing T), and some are steeply sloped (small or no changes in MF with increasing T). These differences are a function of both the protolith type and percentage within the starting rock mixtures.

Modeling of fractional crystallization processes using a least-squares-fit program closely matches many of the experimental results.

K-rich fluid infiltration is evident in xenoliths from the deep crust and mantle beneath the Sierras and may indicate that K-metasomatism played an important role in generating the voluminous Sierran granites, rather than involvement of distinctly different crustal source rocks.