P-T-t conditions for the regional very low-grade metamorphism in the Lower Cretaceous of the Coastal Range in central Chile: geodynamic implications

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In the Coastal Range of central Chile (≈32° 35' – 33°10'S), a non-deformative very low-grade extensional-type metamorphism is widely present in Lower Cretaceous volcano-sedimentary successions deposited in a basin environment. This metamorphism is characterized by sub-greenschist facies mineral associations, increasing in grade with stratigraphic depth from pumpellyite-bearing zeolite facies at the top to subordinate greenschist facies at the base (Levi et al., 1989). Nevertheless, the most widely represented facies is prehnite-pumpellyite mostly originated in the mafic volcanic rocks of the *Veta Negra Formation*. Most common metamorphic minerals are pumpellyite, chlorite, K-feldspar, white-mica (sericite) and epidote accompanied by minor quartz, albite and prehnite; subordinate actinolite is present at the bottom of the sequence. These minerals appear as pseudomorphs of primary minerals, as groundmass replacement, and filling amygdales. Based on chlorite composition and thermodynamic calculations, P-T conditions of ≈ 250-300°C and ≤ 3 kbars were obtained from low-variance assemblages hosted in amygdales of rocks in the prehnite-pumpellyite facies.

$^{40}Ar/^{39}Ar$ plateau ages of 93.1 ± 0.3 Ma - 96.8 ± 0.2 and 97.0 ± 1.6 Ma were obtained from (i) adularia ($Or_{97}Ab_3$) in low variance assemblages filling amygdales together with pumpellyite, chlorite, epidote and minor prehnite and (ii) strongly sericitized plagioclase. These figures constraint to 25-22 Ma the time-interval between volcanism, dated at ≈119 Ma, and metamorphism (Aguirre et al., 1999; Fuentes et al., 2005). A K-Ar age of 100±3 Ma (Morata et al., 2006) has also been obtained from celadonite in amygdale (paragenetic with chlorite, quartz and calcite) in lavas of the upper Lower Cretaceous formations. Coincidence in metamorphic and plutonic ages (Parada et al., 2005) in the region suggests that additionally to burial, an anomalous thermal gradient reflected by a regional magmatism was also present during the metamorphic event. Differences in the ages obtained from the very low-grade minerals dated (adularia, sericite and celadonite) can be interpreted in terms of its thermochronological significance. Thus, the plateau age of 93.1±0.3 Ma in the Bustamante section (Aguirre et al., 1999) could represent a minimum age for the prograde metamorphism. Moreover, precise dating of the metamorphism allows to constraint the maximum ages of the subsidence and extension (marking the climax of metamorphism) and, consequently, the timing of closure and inversion of the basins as a consequence of changes in the regional geodynamic setting from extensional to compressional.

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References

Aguirre, L., Féraud, G., Morata, D., Vergara, M. and Robinson, D. (1999). Tectonophysics, 313, 433-447.

Fuentes, F., Féraud, G., Aguirre, L. and Morata, D. (2005). Chem. Geol., 214, 157-177.

Levi, B., Aguirre, L., Nyström, J., Padilla, H. and Vergara, M. (1989). J. Met. Geol., 7, 487-495.

Morata, D., Belmar, M., Pérez de Arce, C., Arancibia, G., Morales, S. and Carrillo-Rosúa, F.J. (2006). V-SSAGI, 25-28.

Parada, M.A., Féraud, G., Fuentes, F., Aguirre, L., Morata, D. and Larrondo, P. (2005). J. Geol. Soc. London, 162, 273-287.