MAGNETIC FABRIC AND FIELD EVIDENCE FOR THE CONSTRUCTION OF THE CALEU PLUTON BY MULTIPLE INJECTIONS AND DOMING COAST RANGE OF CENTRAL CHILE

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INTRODUCTION

Recent field studies on mid- and upper-crustal plutons of different tectonic setting, combined with modelling of emplacement mechanism have shown laccolith-type geometry (fed by vertical dikes), which result from a mechanism of space generation dominated by roof uplift and/or floor depression (e.g. Petford, 1996; Benn et al., 1998). This study presents the results concerning with the construction of a typical Andean shallow-emplaced granitoid pluton, based on the combination of magnetic fabrics and field observations. The dominant processes in the construction of the pluton were 1) multiple upward magma injections by dikes, and 2) thickening of laccolith-shaped pluton by roof doming to accomodate the increasing volume of magma.

THE CALEU PLUTON

The Caleu pluton, located in the Coast Range of central Chile c. 40 km northwest from Santiago, corresponds to the late (94.5 ± 2.2 Ma) event of the Early Cretaceous magmatism. Strata of its volcano-sedimentary envelope were deposited in a Early Cretaceous subsiding basin (Vergara et al., 1995) and currently are tilted about 30-50° to the east. Testimony of the roof have been locally observed near the southern end of the pluton. The anatomy of the pluton consists in three N-S elongated zones (Fig. 1), which define an accross-pluton compositional variation characterized by a westward increase in SiO_2 content. The three zones are: Gabbro-Diorite Zone (GDZ),

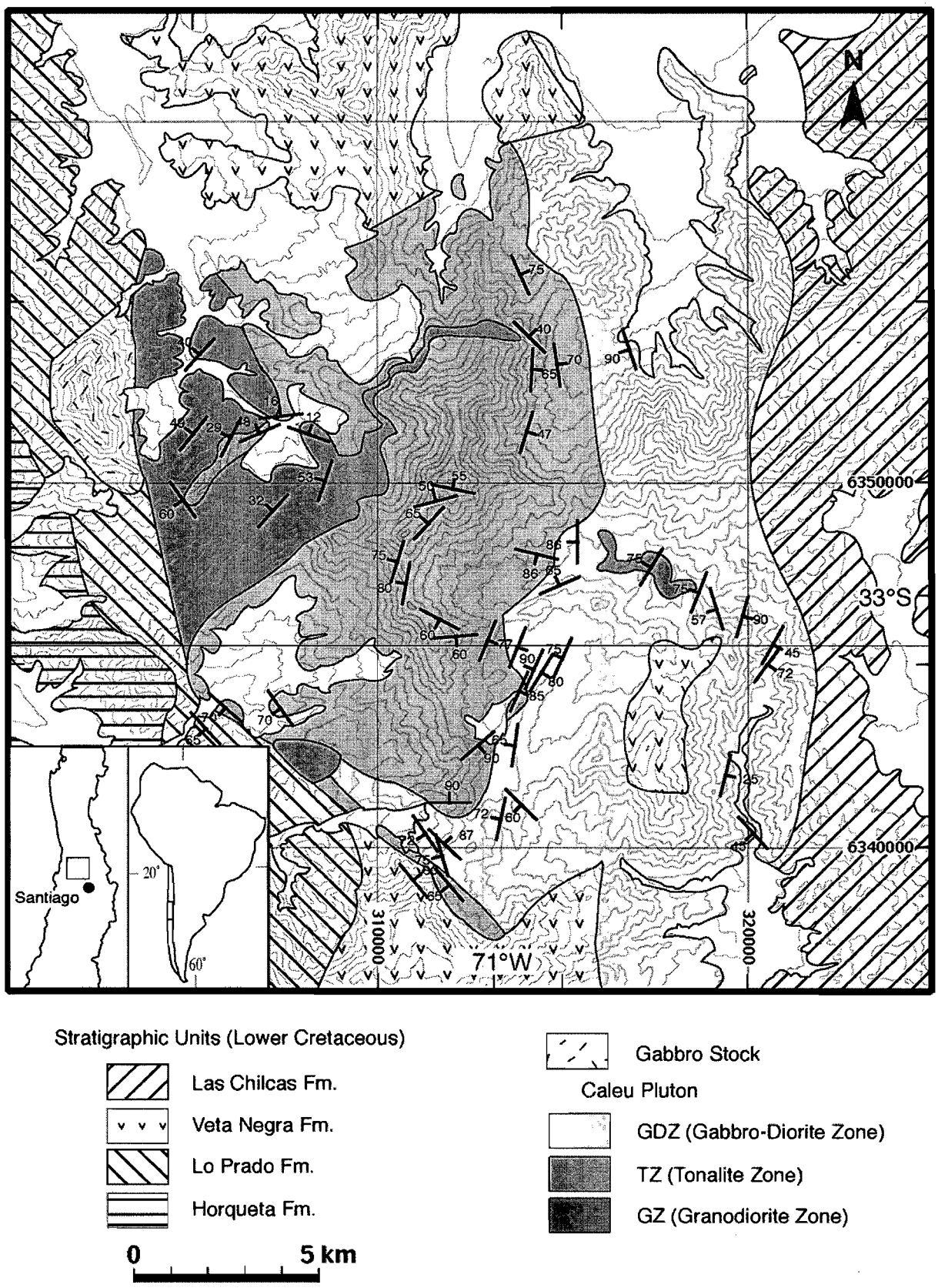

Figure 1: Geological map of the Caleu Pluton. Magnetic foliations define large-scale magmatic structures within the different Pluton units. The numerical values correspond to the dip of the foliation planes.

Tonalite Zone (TZ) and Granodiorite Zone (GZ). The zones were emplaced episodically from mafic to felsic, and their distinct compositional characteristics were not acquired *in situ* but in a subjacent stratified reservoir (Parada et al., 2002). Magnetite is the the ferromagnetic minerals that, by far, make the most significant contributions to the magnetic susceptibility of the three zones, followed by the paramagnetic minerals (mainly biotite and hornblende).

The pluton as a whole is macroscopically isotropic. However, a strong tectonic deformation and recrystallization is locally observed in a rock strip of few meters width along the southwestern margin. This deformation is indicated by a N40°W/65°-80°SW foliation, and a stretching mineral lineation within the foliation plane. Some mafic varieties of the central part of the GDZ exhibit a magmatic mineral lineation, defined by the alignement of euhedral prismatic plagioclase and amphibole crystals.

REMANENT MAGNETIZATIONS AND ANISOTROPY OF MAGNETIC SUSCEPTIBILITY

A total of 547 cores were drilled at 68 sites within the different zones (Fig. 1). The highest values of magnetic susceptibility and remanent magnetization are found in the GDZ (0.04 – 0.1 SI), whereas the lowest values are observed in the GZ (0.01-0.02 SI). Remanent magnetization of samples from the GDZ is more stable than the remanent magnetization of samples from the GZ. This suggests that the increase in magnetite content from the GZ to the GDZ is not associated with an increase in grain size. Normal polarity of the remanent magnetization is observed at all sites. A well-defined characteristic magnetization was determined at 51 sites. Except at four sites near the eastern border of the pluton where deformation can be inferred from the paleomagnetic data, paleomagnetic results show very little dispersion within the three units. The average direction for the pluton (47 sites: declination: 12.4°; inclination: -55.7°; a95: 1.7°) is slightly different from the expected direction at 95Ma determined from the new Apparent Polar Wander Path [Besse and Courtillot; 2002] (declination: 355.7°; inclination: -53.7°). The difference is best explained by a clockwise rotation of the pluton of 16.7°±6.7. This implies that the pluton intruded after tilting of the host volcanic succession.

AMS was measured with the KLY3-S Agico Kappabridge. Five to ten samples were measured at each site. AMS is not very strong and the largest foliation values do not exeed 15%. Shapes of AMS ellipsoids are usually oblate and only a few sites show a prolate ellipsoide. Dip of the foliation planes are steep within the GDZ and TZ zones and shallow dips are observed in the Granite zone of the pluton (Figure 1). On the southwestern border of the Pluton, foliations are sub-parallel to the contact with the Veta Negra country rock. These NW oriented contacts have previously been interpreted as evidence for NW oriented sinistral fault zones. However, only steep vertical magnetic lineations are observed. Moreover remanent magnetizations within the Pluton and within the remagnetized Veta Negra country rock do not show evidence for significant deformation posterior to the intrusion.

SPACE CREATION

Despite the subquadratic shape in plan view of the whole pluton, the zones are elongated exhibiting predominantly concordant magnetic foliation as predicted by emplacement of vertical tabular bodies. It seems likely that each zone was feeded from its respective reservoir by dikes in an episodic way by considering the

westward progression of the zone emplacement with time evidenced by the observed intrusion of TZ into GDZ and GZ into TZ. The space creation for horizontal plutons has been mainly explained by stoping, roof lifting, floor depression, lateral magma propagation and a combination of them (Cruden, 1998). In the case of the Caleu pluton wall-rock xenoliths were not found, thus stoping would have not play a significant role as a mechanism of space creation. We think that roof lifting (doming) and floor depression would have operated. Doming can be evidenced by the dome-like structure generated by the magnetic foliation measured at the center of the pluton (Figure 1). The inflation of the Caleu pluton was produced by succesive pulses that pushed up earlier ones. The lower section of the dome consists of about 800 m of vertical exposure of mafic enclave-bearing tonalite. The upper section is abruptly marked by the ocurrence of enclave-free gabbro-diorites. The density inversion in this rock column is explained by a tonalitic intrusion nested into a previous gabbro-dioritic pulse. The mafic enclaves in the tonalite are crude testimony of mingling between the pulses, particulary if one considers that the larger amount of enclave are observed near the contact with the upper gabbro-diorite. Floor depression seems to be likely by considering the inferred presence of a subjacent reservoir from which the pluton was formed (Parada et al., 2002). In this scenario, downward displacement of the underlying host rocks is promoted by the crustal space vacated by the ascended magma.

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