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Discussion

Comment on "Petrography and Petrology of the Calc-Alkaline Sarıhan Granitoid (NE Turkey): An Example of Magma Mingling and Mixing"

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Preamble: In a recent paper, Aslan (2005) presents so far unique petrographic and geochemical data on Sarıhan granodiorite from Eastern Pontides, NE Turkey. Several microtextural characteristics in conjunction with microgranular enclaves are accounted for mingling and mixing of distinct magmas. Tentatively a hybrid origin is suggested. As we have been working on the geodynamic evolution of the Eastern Pontides for several years, we have grown interested in his results. However, we were altogether disappointed to see (a) overall omission of some lithological units in the geological map of the area, and inconsistencies of field relations with the previously published and well-known data, (b) miscalculation of the age value of intrusion from the Rb-Sr whole-rock data and, (c) misidentification of some microtextures and failure to recognize the true nature of the Sarıhan granodiorite. Hence, we, consider it necessary to comment briefly on this paper.

Geological Setting

A close inspection of Aslan's geological map (*figure 3*) reveals presence of basically four points conflicting with those in the previously published maps of the area (Okay & Leven 1996; Okay *et al.* 1997; Çapkınoğlu 2003). In order to enable a comparison, geological map of Okay *et al.* (1997) is reproduced in Figure 1. These are: (i) Omission of several lithological units in the geological map of Aslan (2005), such as Late Carboniferous sedimentary rocks immediately at the northwest contact of the Saraycık granodiorite and Late Palaeocene–Early Eocene flysch (Spikör Formation), ~1 km to the south of the Sarıhan granodiorite. (ii) Age of the Saraycık granodiorite: a Permian age is assigned to Saraycık granodiorite similar to Tanyolu (1988), disregarding more recent studies where Eocene age is testified by the field relations (Okay *et al.* 1997) and $^{40}Ar/^{39}Ar$ biotite ages (Topuz *et al.* 2002, 2004a, 2005). (iii) Field relations around the Sarıhan granodiorite: Sarıhan granodiorite crosscuts the Liassic volcanoclastics, Early Cretaceous limestones and ophiolitic mélange. However, in the geological map of Aslan (2005), the ophiolithic mélange has no contact with the Sarıhan granodiorite. Formation and emplacement of the ophiolithic mélange are constrained to Aptian–late Campanian interval by Okay *et al.* (1997), indicating that the Sarıhan granodiorite was emplaced during late Campanian or later (≤ 74 Ma). (iv) Tectonometamorphic units within the Pulur complex: Aslan (2005) differentiates three regional metamorphic units of distinct grades, which constrast with the previously published data (cf. Okay 1996; Topuz & Altherr 2004; Topuz *et al.* 2004b,c).

Age of the Intrusion

Based on three whole-rock Rb-Sr isotopic data (reproduced in Table 1), Aslan (2005) calculates an age value of 66.6±2 Ma (Maastrichtien) for the Sarıhan granodiorite. If true, the Sarıhan granodiorite will be the first example of Late Cretaceous magmatic activity to the south of Gümüşhane and Pazaryolu line (e.g., Okay & Şahintürk 1997). However, the isotopic ratios of the two samples (S2 & S4) are indistinguishable within the range of analytical uncertainty (*Table 1*), therefore it is essentially a highly uncertain two-point isochron. Furthermore, recalculation of the age value manually and by Isoplot software of Ludwig (2003) yielded an age value of 75±40 Ma (2σ): *We could not reproduce the age*

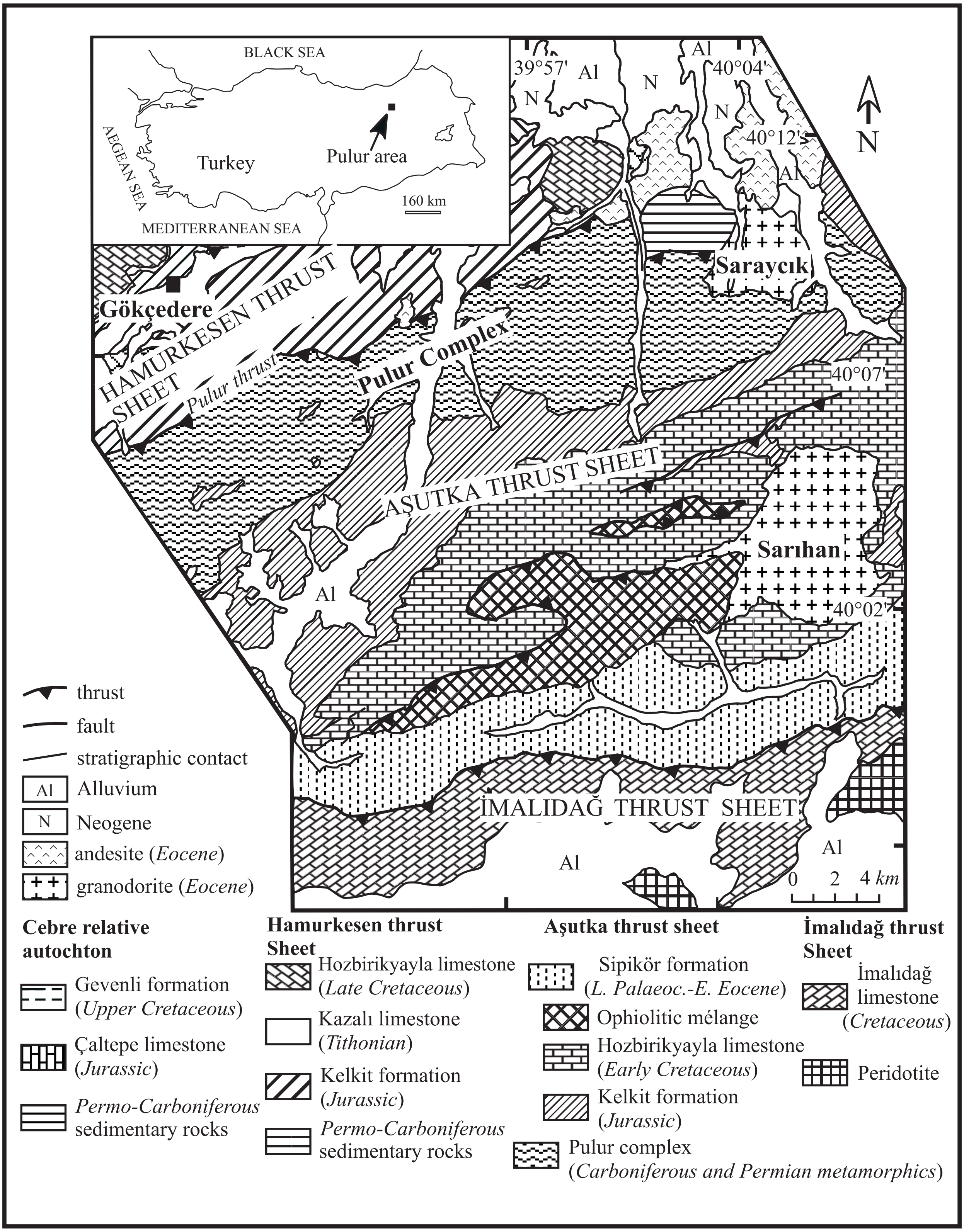

Figure 1. Generalized geological map of the Pulur area (modified after Okay *et al.* 1997). Inset shows the location of Pulur area within Turkey.

Table 1. Rb-Sr isotopic whole-rock data (Aslan 1997)

Sample	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr^a$	$^{87}Sr/^{86}Sr^b$	Age (Ma)
S2	72.9	909.90	0.2274	0.70502±1	74±38 (S2-S4-S6)
S4	73.4	917.20	0.2269	0.70502±2	74±44 (S4-S6)
S6	84.9	877.40	0.2746	0.70507±2	75±44 (S4-S6)

[a] 2–σ error is 1 %; [b] 2σ error is 0.003 %

value (66.6±2 Ma) given by Aslan (1998, 2005). On the basis of common Eocene volcanism and absence of Late Cretaceous volcanism in the area, Okay *et al.* (1997) assigned an Eocene age to the Sarıhan granodiorite.

Petrography and Petrology

A careful examination of the whole rock data reveals that the Sarıhan granodiorite is a high Ba-Sr granitoid, unnoticed by the author (e.g., Tarney & Jones 1994; Qian *et al.* 2003; Figure 2). A/CNK values [= molar $Al_2O_3/(Na_2O+CaO+K_2O)$] of some samples and Mg# [100*molar MgO/(FeO+MgO)] are miscalculated (*table 3* in Aslan 2005): Recalculation gave A/CNK and Mg# values of 0.85–1.09 (metaluminous to peraluminous) and 61–84, respectively. Mg#'s and concentrations of some trace elements such as Pb and La (Pb: up to 140 x enriched relative to average continental crust; La: up to 535 x chonditic) are unusually high (cf. Boynton 1984; Wedepohl 1995). These are left totally untouched. There

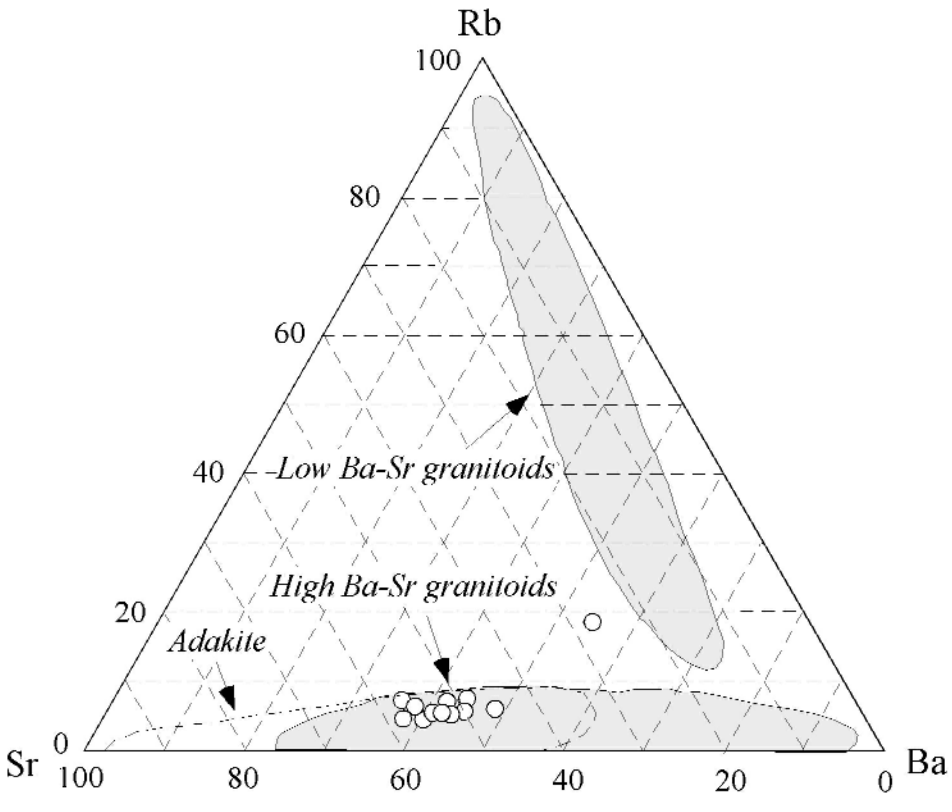

Figure 2. Sr–Rb–Ba plot for the Sarıhan granodiorite (after Qian *et al.* 2003 and the references therein).

is also no statement on the analytical uncertainties and how Fe_2O_3 and FeO have been determined. Totals of some hornblende and biotite analyses are unacceptably low. All these indicate that the whole rock and mineral analyses are of doubtful quality.

Aslan (2005) describes a number of disequilibrium microtextures such as antirapakivi and plagioclase with cellulose core, like those described in Barbarin & Didier (1991). The microtexture in *Figure 5b* is misidentified as antirapakivi: late crystallizing K-feldspar incorporates a framework of early crystallized plagioclase, filling the intercities left behind. However, in a real "antirapakivi" texture, K-feldspar should have formed a mantle on plagioclase. Late nature of K-feldspar is supported by microtextures in the other micrographs (*figure 5c-e*) where K-feldspar consistently surrounds all the other phases. In the last paragraph of page 192, Aslan (2005) states that K-feldspar megacrysts in microgranular enclaves (no micrograph is given in the paper) can mechanically be transferred from the host granodiorite: *This is not relevant for his case because a late crystallizing phase in a magma with lower solidus temperature cannot be incorporated into microgranular enclaves with higher solidus temperature*. The disequilibrium textures such as plagioclases with cellulose cores and mantling of biotites by hornblende can also be produced by variation of intensive parameters during crystallization, not necessarily by mixing of distinct magmas (e.g., Pietranik *et al.* 2006).

In addition to the disequilibrium textures in the granodiorite, Aslan (2005) uses presence of microgranular enclaves as evidence for the hybrid origin of the granodiorite. Enclaves in the granitoids are ascribed to distinct origins such as (a) mingling of mantle and crust-derived magmas (e.g., Barbarin & Didier 1991), (b) restitic residues of partial melting or samples of unmelted, refractory material from the source region (e.g., Chappell 1996; White *et al.* 1999), (c) products of the rapid cooling at the magma conduits through which granitic magmas was emplaced into the upper crust (e.g., Donaire *et al.* 2005 and the references therein), (d) cumulates of early formed minerals and trapped interstitial liquids (e.g., İlbeyli & Pearce 2005 and the references therein). Aslan (2005) presents no geochemical and petrographic data on the microgranular enclaves to exclude the other possibilities. Magma mingling and mixing is one of the possibilities to produce microgranular enclaves and disequilibrium textures, but not necessarily the only ones.

Initial $^{87}Sr/^{86}Sr$ values (~0.7048–0.7051) of the three whole rock samples are very similar to the bulk earth, precluding significant assimilation of crustal material during magma ascent and emplacement at the upper crustal levels. It cannot be taken as an evidence for the hybridic origin. The author should also provide isotopic evidence for the presence of distinct magmas.

Conclusions

The paper contains substantial errors and inconsistencies with itself and previously published data. Parts of the presented geochemical data are of poor quality. On the whole, the proposed interpretation is merely a contention and appears not to be founded on correctly established facts.

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