Earth and Planetary Science Letters 366 (2013) 83–98

Contents lists available at SciVerse ScienceDirect

Earth and Planetary Science Letters

journal homepage: www.elsevier.com/locate/epsl

Reconstructing the geometry of central Anatolia during the late Cretaceous: Large-scale Cenozoic rotations and deformation between the Pontides and Taurides

Côme Lefebvre [a,b,*], Maud J.M. Meijers [b,c], Nuretdin Kaymakci [d], Ahmet Peynircioğlu [c], Cor G. Langereis [c], Douwe J.J. van Hinsbergen [e]

[a] Structural Geology and Tectonics Group, Department of Earth Sciences, Faculty of Geosciences, Utrecht University, Budapestlaan 4, 3584 CD Utrecht, The Netherlands
[b] Géoazur, UMR 7329, Université de Nice Sophia Antipolis, Observatoire de la Côte d'Azur, Parc Valrose, 06108 Nice, France
[c] Paleomagnetic Laboratory 'Fort Hoofddijk', Department of Earth Sciences, Faculty of Geosciences, Utrecht University, Budapestlaan 4, 3584 CD Utrecht, The Netherlands
[d] Department of Geological Engineering, Middle East Technical University, 06531 Ankara, Turkey
[e] Physics of Geological Processes, University of Oslo, Sem Sælands vei 24, NO-0316 Oslo, Norway

ARTICLE INFO

Article history:
Received 14 June 2012
Received in revised form
2 January 2013
Accepted 4 January 2013
Editor: T.M. Harrison
Available online 19 March 2013

Keywords:
Central Anatolia
paleomagnetism
granitoids
rotation
collision

ABSTRACT

The Central Anatolian Crystalline Complex (CACC) exposes metamorphic, ophiolitic and igneous rocks that were formed and deformed during closure of the Neotethyan ocean. The CACC is located in central Turkey, between the Pontides in the north and the Taurides in the south, separated by major fault zones. Composite plutons intruded the meta-sedimentary and ophiolitic units between ~95 and 75 Ma, and form linear magmatic belts (~100 km long) along the western and northern margins of the CACC. Exhumation of the metamorphic and igneous complex was finalized by the Paleocene time. In this study, we paleomagnetically study fifteen plutons spanning the entire non-deformed upper Cretaceous granitoid belt to test whether the initial configuration of the CACC was modified by vertical axis rotations after its exhumation. Our results show three internally coherent domains with significantly different vertical-axis rotations: (1) in the north-east, the Akdağ–Yozgat block (AYB) records ~15° clockwise rotation, (2) in the north-west, the Kırşehir–Kırıkkale block (KKB) shows ~6–9° counter-clockwise rotation and (3) in the south-west, the Ağaçören–Avanos block (AAB) shows 28–35° counterclockwise rotation. We propose that these rotations were accommodated by two transpressional fault zones: in the south, the existing Savcılı Thrust Zone between the AYB and KKB and in the north, the newly introduced Delice–Kozaklı Fault Zone between the KKB and AAB. The restored configuration of the CACC suggests that the three blocks were largely aligned in a ~NNE orientation at an early stage of their history. Consequently, since the late Cretaceous the shape of the CACC was affected by large scale deformation, resulting in its modern triangular geometry. This deformation phase is best explained as a result of collision of the CACC with the Pontides.

1. Introduction

The Central Anatolian Crystalline Complex (CACC) is the largest metamorphic domain exposed in Turkey, and covers a triangular area of ~250 × 250 × 250 km (Fig. 1). Its tectonic history involves regional Barrovian metamorphism and widespread magmatism during the late Cretaceous (e.g. Erkan, 1976; Göncüoğlu, 1986; Whitney et al., 2003; Boztuğ and Jonckheere, 2007), followed by extension-driven exhumation of the crystalline rocks at the Earth's surface (Whitney and Dilek, 1997; Gautier et al., 2002; Isik et al., 2008; Lefebvre et al., 2011, submitted for publication). However, the geodynamic context of its extension and exhumation remains poorly understood, mainly because soon after exhumation the CACC started colliding with the central Pontides in the Paleocene (Görür et al., 1984, 1998; Kaymakci et al., 2000, 2003a, 2003b, 2009; Meijers et al., 2010), leading to compression in central Anatolia throughout the Paleogene (Şengör and Yilmaz, 1981; Görür et al., 1984; Kaymakci et al., 2003b; Gülyüz et al., in press). Folding and thrusting affected basins surrounding (e.g. Çankırı, Tuzgölü, Sivas basins) and overlying (e.g. Kırıkkale, Çiçekdağ and Ayhan basins) the CACC (e.g. Görür et al., 1984, 1998; Poisson and Guezou, 1996; Köksal and Göncüoğlu, 1997; Dirik et al., 1999; Kaymakci et al., 2009, Advokaat, 2011; Gülyüz et al., in press) (Fig. 1b). The most prominent compressional feature in central Anatolia is the

* Corresponding author. Present address: Department of Earth Sciences, University of Minnesota, MN 55455, USA. Tel.: +1 612 624 8557.
E-mail address: lefebvre@umn.edu (C. Lefebvre).

0012-821X/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.epsl.2013.01.003

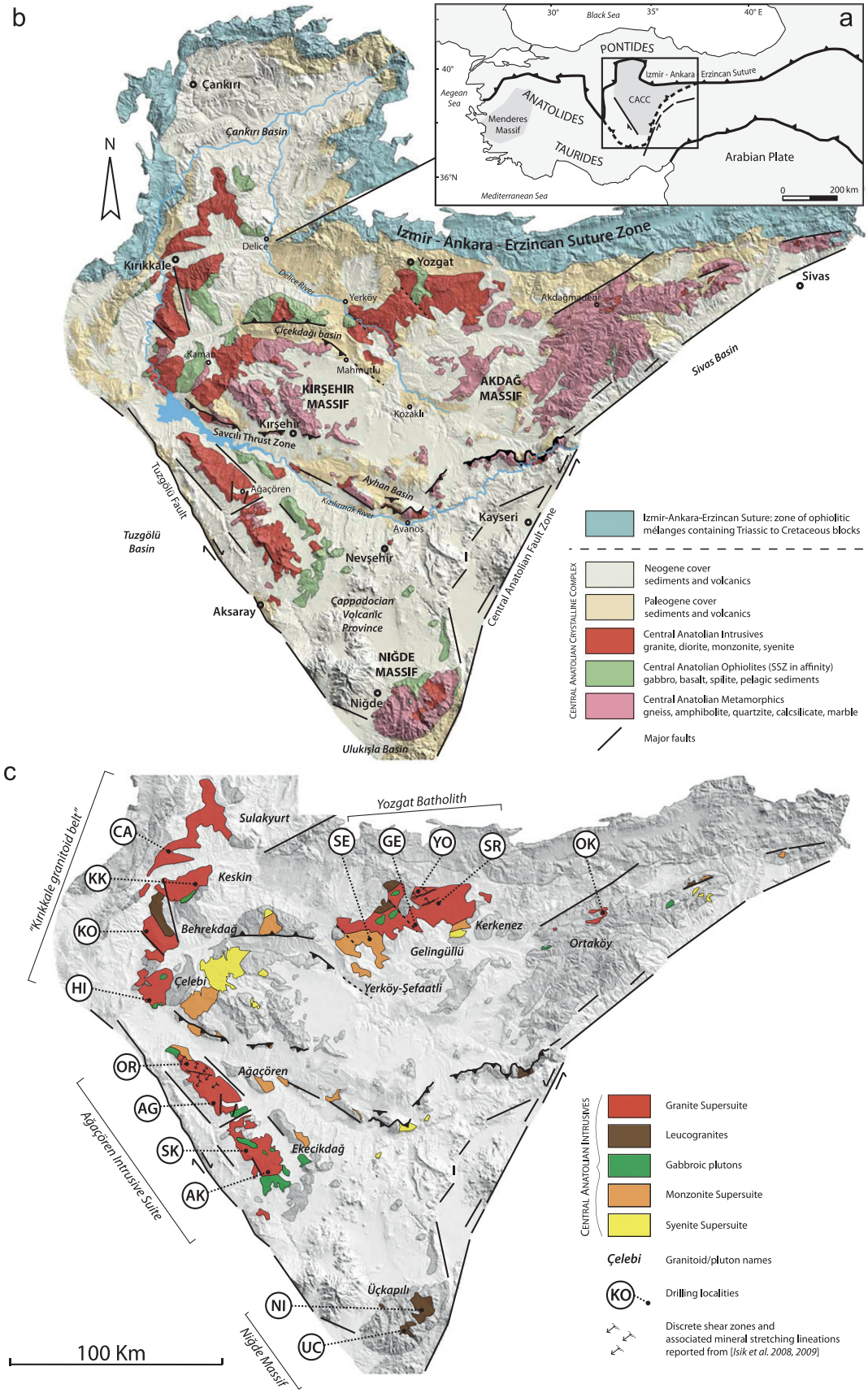

Fig. 1. (a) Simplified tectonic map of the Turkish orogenic system. The two gray areas indicate the location of the two largest metamorphic massifs in Turkey: the Menderes Massif and the Central Anatolian Crystalline Complex (CACC). (b) Simplified geological map of the CACC projected onto a Digital Elevation Model. (c) Composite map of the CACC showing (1) the distribution of the main central Anatolian magmatic supersuites (modified after Kadıoğlu et al., 2006) and leucogranites (modified after Tatar et al., 1996); (2) the pattern of brittle faults affecting the plutons (after Erler and Göncüoğlu, 1996) and the discrete shear zones cutting across the Ağaçören and Kerkenez granitoids (after Isik et al., 2008; Isik, 2009); and (3) the locations and sampling codes of the fifteen paleomagnetic sampling localities, with the names of associated granitoids (after Akiman et al., 1993 for the western granitoids and after Erler and Göncüoğlu, 1996 for the Yozgat Batholith).