Mesozoic and Tertiary tectonics of the Munzur gorge region, eastern Turkey: Cretaceous plate collision, late Cretaceous–Eocene orogenic collapse and Neogene lateral extrusion

Franz Neubauer[1], Irmina Pöschl[2], Waltraud Genser[2], Martin Müllegger[2], Johannes Kleberger[2] & Orhan Simsek[2]

1 Department Geography and Geology, University of Salzburg, Hellbrunner Str. 34, A-5020 Salzburg, Austria (franz.neubauer@sbg.ac.at)

2 iC Consulenten Ziviltechniker, Zollamtsstr. 1, A-5101 Bergheim, Austria

Within the Alpine-Himalayan orogenic belt, Turkey has a key position as it comprises two ophiolite belts originating from two different major oceans. The northern, Palaeotethys ocean has been consumed during Triassic, and the southern Neotethys ocean during late Cretaceous and/or early Tertiary. Here we present new data from the Munzur gorge area crossing the SE foothills of the Munzur Mountains that are situated within the easternmost wedge of the present-day Anatolian Block, bounded by North Anatolian Fault (NAF), the Malatya-Ovacik Fault and the East Anatolian Fault (EAF). There, the Keban Metamorphic Complex is exposed in the footwall of the Ovacik Ophiolite (Neotethys). The working area comprises a number of lithostratigraphic units, which include and which allow deduce the following tectonic history:

The Keban Metamorphic Complex comprises marble, phyllite, graphitic schist and rare greenschist. Several new $^{40}Ar/^{39}Ar$ white mica ages (including a plateau age of 100 ± 1 Ma) from phyllite and quartzite constrain the Cretaceous age of metamorphism likely related to the emplacement of the Ovacik ophiolite. Metamorphism was associated with ductile deformation, likely thrusting.

We interpret overlying dark mica-rich sandstones to represent an erosional remnant of the Upper Senonian flysch-type Kemaliye Formation elsewhere. $^{40}Ar/^{39}Ar$ ages of detrital white mica range from 70 to 95 Ma and comprise two age clusters at ca. 88–90 Ma and 77–79 Ma, which reveal younger stages of metamorphism in the source region of the sandstone as in the Keban Metamorphic Complex.

The Cretaceous orogenic wedge collapsed, resulting in the late Cretaceous formation of the Keban Basin (Group). The main stages of subsidence in the Keban basin were during Maastrichtian and Eocene times and led to the deposition of the terrestrial Gözerek Conglomerate and the marine Lower Konaktepe Formation, the later showing evidence of syndepositional folding. The Keban Group comprises several formations, which include from base to top: (i) the basal massive coarse conglomerate with a thickness of ca. 40–80 metres, mainly exposed the Munzur valley; (ii) the well bedded Gözerek Conglomerate with a thickness of ca. 400 to 40 metres, outcropping along the southern slope of the

Munzur gorge; the Gözerek Formation has a suggested Maastrichtian age although no fossils have been found in the region; (iii) a ca. 1,100 m thick package of well-bedded brownish sandstone, silty dark marls, arkose layers and well bedded marls with sandstone intercalations here named as the Lower Konaktepe Formation and distinguish it from the overlying Upper Konaktepe Formation by the absence of major volcanic intercalations.
The overlying Upper Konaktepe Formation mainly comprises ash tuffs and agglomerates of Neogene age.
The overlying Torunoba Formation comprises thick, flyschoid volcanic material, mainly ash tuffs and nonvolcanic shales.
A granitoid suite intruded the Keban Group to the S of the Munzur valley. $^{40}Ar/^{39}Ar$ biotite ages of ca. 18 Ma from a porphyric diorite and a porphyric granodiorite dyke are interpreted to date the age of cooling of the plutonic suite below ca. 300°C. The intrusion of the granitoid suite resulted in contact metamorphism of the Lower Konaktepe and subordinately Gözerek Fms. and in the underlying Keban Metamorpic Complex. Calcsilicate gneisses, skarn-like diopside calcsilicate rocks and recrystallization of marls, limestones and dolomites to marbles are observed. Neogene granitoids intruded in a NE-SW extensional regime, which was likely associated to the NW–SE compressive strike-slip faults. Intrusions also caused hydrothermal alteration and ore mineralization.
The larger area is confined by the prominent the dextral North Anatolian Fault and the sinistral East Anatolian Fault and is usually referred to as the Anatolian Block that escapes, driven by indentational forces, towards the west. Respective movements were recently proven by measurements of the global positioning system (GPS). Recently, a tectonic model was proposed to explain the eastward migration of a triple point from the Neogene Ovacik basin region towards Karliova. The Neogene SW-trending Malatya-Ovacik fault was replaced by the younger East Anatolian fault.
Many new fault zones have been detected. A detailed study of fault zones and fault rocks allow establishing a succession of palaeostress stages. Compressive tectonism resumed in Neogene times with (W)NW–(E)SE directed compression. The whole region was and is affected by late Neogene to Recent uplift related to late-stage N-S directed compression. The pop-up-type compression and shortening of the area between North and East Anatolian faults led to the development of a conjugate set of NNE-SSW and NNE-SSE trending, steeply dipping strike-slip faults, to strike-slip reactivation of earlier extensional faults and to the formation of oversteepened slopes and the Munzur gorge due to ongoing rapid surface uplift. The observed young strike-slip faults affecting the area are part of the regional NAF/EAF fault system and must be considered potentially active as distribution of seismicity reveals.