system. A joint cooperation between the Institute of Geodynamics - Bucharest and the Geophysical Laboratory - Aarhus on the heat flow and lithosphere evolution in the Transylvanian and Pannonian basins started in 1996 as a contribution to the subproject "Paleo Heat Flow and Fluid Flow in the Transylvanian and Pannonian Basins" of the PANCARDI Project of EUROPROBE. Funding is provided by the Romanian Academy and the Danish Natural Science Research Council.

A campaign of borehole temperature measurements was undertaken in August 1996 and the data from 12 thermally stabilized boreholes in unsampled areas of the Transylvanian Basin will be reported in this paper. The logging system built by the Geophysical Laboratory of Aarhus University consists of a quartz thermometer, a winch driven by an electric motor, a two conductor cable of length 1.5 km, a cable counter for depth measurement and a PC for data acquisition. The power is supplied by a generator. The temperature measurement system is based on the counting of the frequency of a quartz oscillator. The advantages of this system over a thermistor based four conductor system are high stability and the requirement of only a two conductor cable. The quartz crystal is cut to produce an almost linear temperature coefficient of about 1 kHz per degree. The frequency of the quartz crystal is about 9 MHz. Because such a high frequency leads to transmission problems over a long borehole cable the frequency is divided using a CMOS divider prior to transmission. At the surface the signal is filtered, amplified and multiplied to yield a frequency of about 28 MHz. The power requirements of the probe is 10 mA which is supplied from the surface via one of the two conductors. As the boreholes were only partially filled with water, the system was used in the continuous logging mode, with a few stops in the air column to obtain the parameters characteristic to the heat transfer from borehole to thermometer. A deconvolution procedure has been used to derive temperature and gradient variations with depth.

Neogene magmatism and tectonics in the Carpatho-Pannonian region

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Neogene magmatism in the CPR can be classified into (a) an earliest phase of highly siliceous acidic pyroclastic tuffs and ignimbrites, (b) slightly younger volcanism of calc-alkaline affinity, identical in its petrography and geochemistry to subduction-related magmatic rocks worldwide; and (c) a generally later phase of alkaline volcanism, similar to the late Tertiary/Quaternary intraplate activity elsewhere in Europe. An unsolved problem is the origin of the widespread early acidic magmatism which began in several regions 19 Ma ago. It may be linked with lithospheric delamination, in which hot asthenosphere was brought into direct contact with the base of the crust, heating it and causing melting. Such a hypothesis can be tested using isotopic and other geochemical methods.

The acid magmatism was followed by the formation of subduction-related andesitic stratovolcanoes along the West Carpathian arc at ca. 16 Ma. The majority of these calc-alkaline volcanoes were extinct by 10 Ma, an age which coincides with a major E-W compressional event in the region, possibly related to the entry of continental crust into the subduction zone. Thus, if oceanic subduction were responsible for the calc-alkaline magmatism, then the subducted slab first reached the required depth for magma generation of 100-120 km (the "magma generation window") simultaneously beneath the whole of the Western Carpathians around 16 Ma ago and ceased to generate calc-alkaline magma about 6 Ma later.

However, in the Eastern Carpathians there is significant calc-alkaline magmatism younger than 10 Ma, showing an age-progression along the chain from 10 Ma in the north to 0.2 Ma at the southern end of the chain. If an oceanic slab subducted beneath the East Carpathians then it must have reached the magma generation window at a progressively later and later time. It takes a finite time for a subducted slab of oceanic crust to reach the temperature and depth of the magma-generation window; this time-lag could account for the gap between the cessation of tectonism and the onset of magmatism. The time interval between the beginning of subduction and the arrival of the subducting slab in the magma generation window will be a function of the angle of subduction and the rate of subduction. In the East Carpathians the narrow volcanic zone and fast progressive movement of volcanism indicates that the period of time which the slab spent in the magma generation window was short. This in turn suggests that the piece of oceanic crust which was subducted was of small dimension and sank quickly. Slab detachment in the East Carpathians followed the arrival of unsubductible continental crust of the Tornquist zone or East European Platform at the trench around 10 Ma ago.

The oldest extension-related alkaline magmas are about 9-11 Ma old and were erupted just as the calc-alkaline magmatism was waning. This indicates a "switch" from a collisional tectonic regime to an extensional one. After this, alkali basalts occurred sporadically in time and place up

to post-glacial times. These magmas may be related to a widespread upwelling of the asthenospheric mantle beneath Europe. They could not be erupted from the upwelling asthenosphere until after the subducting slab had become detached and had sunk into the asthenosphere. Such "slab window" alkali basalts have been observed in other regions of the world when a subducting slab has been detached.

Pre-Alpine and Alpine metamorphic history of the Sopron Hills (Burgenland, Austria)

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The Sopron Hills, in the borderland between Austria and Hungary, represent one of the easternmost occurrences of the Central Alps towards the Carpatians and in spite of the poor outcrop situation they play an important part in understanding the geology of this area. Andalusite (And) - bearing lithologies of presumed pre-Alpine age have been recognised in the Hungarian part of the Sopron Hills for several years. This work deals with the continuation of these rocks into the Austrian part of this crystalline massif. Petrological, geochronological and structural investigations of the partly well preserved pre-Alpine And-bearing rocks give major insights in the *pre-Alpine* metamorphic history, the *Alpine* overprint and the post-mid-cretaceous tectonic exhumation by normal faulting.

Lithologies with a relatively well preserved pre-Alpine mineralogy, which outcrop predominantly in the uppermost levels of the Sopron Hills, comprise the *Óbrennberg-Kaltes Bründl Series (ÓKB)* consisting of schists and feldspar-rich schists with varying amounts of kyanite, sillimanite, and locally preserved andalusite. The rest of the massif with strong Alpine metamorphic overprint comprise gneisses and monotonous diaphthoritic mica schists with varying quartz contents and numerous rectangular to rhomboic pseudomorphs after staurolite (Stau), which is called *Sopron Series (SS)*.

Rb/Sr-mineral-ages in both series show partial Alpine resetting, although this was much more effective in the SS than in the ÓKB, where the oldest mineral-ages of the Sopron Hills are preserved.

The mica schists of both series are geochemically relatively similar. According to major- and traces discrimination diagrams, shales with an island-arc-signature are the most probable protolith for these rocks. Major- and trace-element discrimination diagrams for the amphibolites point to a protolith with ocean-floor-affinity, while the gneisses classify as peraluminous syn-collision granites.

The conditions of the pre-Alpine high-T metamorphism in the *ÓKB* are estimated at 650° C and 3-5 kbar. There is strong evidence for an Alpine metamorphism in the SS, with peak-conditions at 550 ± 30° C and 9.5 ± 1.5 kbar.

The SS in this area is believed to belong to the Lower Austroalpine "Grobgneis Unit", whereas the *ÓKB* show striking similarities to the Strallegger Gneisses and to the „Dist-Paramorphosenschiefer" (Koralpe), which are part of the Middle Austroalpine Units.

Although the present tectonic arrangement is supposed to be partly a result of the large scale nappe-transport during the Alpine orogeny the dominant ductile deformation within the mylonites and leucophyllites (shear bands, strain fringes, scc'-fabric, crystal preferred orientation and shape preferred orientation of dynamically recrystallised quartz) indicates a top-to-SE extension. These micro- and mesoscopic kinematic indicators as well as the geometric arrangement of the ductile to brittle deformation style and the Alpine metamorphic overprint suggests extensional exhumation along a SE-dipping normal fault.

Tertiary tectonic evolution of the Pannonian basin system and neighbouring orogens: a new synthesis of paleostress data

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The combination of a paleostress data base, borehole, gravity and seismic data, paleogeographic and stratigraphic information suggest that 7 major Tertiary tectonic episodes can be recognized in the Pannonian basin and surrounding orogens. The first two episodes affected two, separated major blocks, the East Alpine-Western Carpathian-North Pannonian (Alcapa) and the South Pannonian-Eastern Carpathian (Tisza-Dacia) blocks.

A Middle Eocene to Early Oligocene N-S compression is connected to contractional basin formation in the foreland and hinterland of the Alpine-Carpathian orogenic wedge. Due to the north-westward shift of the Adriatic promontory, the Alcapa terrane was separted from the Southern