Correlation of major tectonic units from the Alps to Western Turkey

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This contribution presents an extension of a previously published tectonic overview (http://pages.unibas.ch/earth/tecto/homepage/Schmid_etal_2008.pdf) into Greece and Western Turkey and discusses along strike similarities and differences. The Dinarides, linked to the Alps along the present-day Mid-Hungarian fault zone (a former transform fault), represent an orogen of opposite subduction polarity in respect to the Alps. The Dinarides and Hellenides consist of thrust sheets containing ophiolitic as well as Adria-derived continental material. These thrust sheets are located in a lower plate position in respect to an upper plate that is composed of the Tisza and Dacia Mega-Units (Dinarides) and Rhodopes (Hellenides), which have European affinities. These tectonic plates are separated by a Late Cretaceous-Early Paleogene suture zone (named Sava Zone), which represents that part of the Vardar Zone that stayed open until end-Cretaceous times and separates upper from lower plate in the Dinarides-Hellenides. This suture can be followed along strike all the way to the Izmir-Ankara suture zone. In the Dinarides and Hellenides parts of the ophiolites of the Vardar branch of the Neotethys Ocean (Western Vardar ophiolites) were obducted already during the latest Jurassic onto the Adriatic margin and were subsequently involved in Late Cretaceous to early Paleogene thrusting. This led to the formation of a series of composite nappes that consist of continent-derived material in their lower part and ophiolites in their upper part. During the latest Jurassic parts of the Vardar Ocean (Eastern Vardar ophiolites) were also obducted and thrust onto the European margin (i.e. the Dacia Mega-Unit), later to become part of an orogen with Europe-vergent structures. Our one-ocean concept does not require the presence of “terranes” separating various oceanic branches along the Neotethys margin, such as the Drina-Ivanjica block or the Pelagonian “massif”. Such continental units simply represent tectonic windows of the distal Adriatic margin, outcropping from below the obducted ophiolitic sheets referred to as Western Vardar Ophiolitic Unit. Moreover, there is no need for a separate ocean linked with Meliata-Maliac ophiolites, because these remnants simply represent the Triassic-age parts of the Vardar Ocean, preserved as imbricates below, or relics within, ophiolitic mélanges accreted in front of the obducted Western Vardar ophiolites. This one-ocean logic can be followed all the way from the Western Carpathians and Dinarides to the Peloponnesus and possibly into the Cycladic Islands. We find no evidence for a Pindos oceanic lithosphere either (i.e. for the so-called “Pindos Ocean”); the Pindos basin simply represents a pelagic seaway located in between carbonate platforms. Furthermore, the derivation of the protoliths of the Cycladic Blueschists, generally also attributed to the Pindos “Ocean”, from oceanic crust is questionable.

By contrast, in Turkey ophiolite obduction clearly occurred during the Late Cretaceous rather than in Late Jurassic times which suggests a major change along strike located somewhere between the Cycladic Islands and the Anatolian peninsula. Moreover, the Menderes massif, tectonically underlying the Cycladic Blueschists, does represent the eastern continuation of the Gavrovo-Tripolitza Zone rather than that of the Pelagonian zone. Another major along-strike change concerns the southeastern continuation of the Carpatho-Balkan orogen, which is considered a part of the Dacia Mega-Unit: the Rhodopes represent a part of the European margin that was northerly adjacent to the Vardar branch of Neotethys and that was subducted northward below Moesia and subsequently partly exhumed as a huge core complex surrounded by normal faults. Hence, it is not clear yet if the Rhodopes, or alternatively the lower part of them (Drama block), were formerly bordered by another branch of Neotethys, originally located to the north of Vardar branch, or alternatively, by the Paleotethys. In other words, the Rhodopes may have been formerly separated from Moesia by oceanic lithosphere located north of the Vardar branch of Neotethys.

Natural stone, an environmentally highly competitive building product

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Civil engineering construction is the largest industry in the world and represents approximately 10% of world GDP. Somewhere around 40 % of the life cycle energy use in residential buildings emanates from embodied energy, i.e. the energy used in the manufacture of building materials and products. The energy consumption of this industry is thus of the utmost importance for a sustainable environment.

The low energy usage during extraction and processing of natural stone building products is a strong marketing potential factor but is very seldom used by stone suppliers. The presentation will focus on why and how to overcome this problem.

The stone industry is a very fragmented industry with little international collaboration. Most stone producing companies are SMEs (Small and Medium scale Enterprises) and have therefore not the financial means to influence international regulations or develop relevant methods for proper calculation of the energy consumption in all steps from the quarry to the final kerb, façade cladding or floor tile.

ECO-labelling could have been an important driver for this process to start. The main problem with the present ECO-labelling system is that it pays too much attention to waste production and the visibility of the quarry and very little to the energy consumption. In addition, it is not a flexible system that takes into the account different needs in different countries or local regions. The present system has been done without the presence of the stone producer and is therefore not supported by the same.

Recent, impartial, comparative investigations show that the production of concrete may use four times more energy than stone (depending on the actual product type) and timber almost forty times, just to mention two examples. In addition, properly chosen stone types will outlast these materials several times over.

In order to effectively make use of this strength, stone producers need to collaborate throughout Europe and agree on common methods that are accepted also by other construction industries. There are several acceptable methods available but also far too common with non serious ones, used to show the advantage of a specific product by merely taking a few of all relevant factors into account.

EUROROCK, the European & International Federation of Natural Stone Industries, has recently initiated a project focusing on colleting the energy use for a large number of specified stone products. In each member country, producers are encouraged to provide information about the energy use for extraction, processing (sawing, grinding, polishing or flaming etc), packaging and transportation for a selection of stone products. Waste production is also taken into account. This is the first major collaboration attempt of European stone producers in this field and has the potential of leading to a change of the ECO-labelling system and will provide stone producers with the very much needed marketing advantage compared to competing products.

Compilation of energy consumption is the first important step towards the demonstration of low environmental impact and enhancement of public acceptance. However, the mapping of all actions and associated energy use is only the starting point for structured improvements of a sustainable stone industry.