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THE ALPS: A PRODUCT OF THE LITHOSPHERIC WEATHER

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The success of the application of the plate tectonic theory is obvious worldwide, except some places, where no clear plate boundaries can be defined. "... Where plate boundaries adjoin continents, matters often become very complex and have demanded an ever denser thicket of ad hoc modifications and amendments to the theory and practice of plate tectonics in the form of microplates, obscure plate boundaries, and exotic terranes. A good example is the Mediterranean, where the collisions between Africa and a swarm of microcontinents have produced a tectonic nightmare that is far from resolved." states Encyclopaedia Britannica.

Recently SZÉKELY (2001) proposed a comprehensive model for tectonically complex regions like the Apenninic-Alpine-Carpathian system, the Indonesian archipelago and the Hunter ridge-Fiji-Lau ridge system: these features are interpreted as products of a widely present lithospheric weather, an analogous phenomenon to the meteorological evolution of air masses. The aforementioned systems are found to be analogous to meteorological low pressure zones both in kinematical and dynamical sense (SZÉKELY 2001). Here we present an overview of the Alpine geological phenomena from the point of view of this model.

The Apenninic-Alpine-Carpathian multiple orogenic loop is a nice example of a geological "cyclone" system termed as geovortex. Because of the extensive set of available data the observations can be arranged into a comprehensive model: for the Apenninic-Alpine segment of the orogen, it is found that the cyclonal center situated NW of Genova separates a warm-front-like part and a cold-front-like part represented by the Alps and the Apennines, respectively.

The crustal thickness (GIESE & BUNESS, 1992; HORVÁTH, 1993) beneath the region is strikingly similar to a meteorological cyclone: the crustal depth pattern forms two steeply (cold) and moderately (warm) dipping, arcuate zones separated by sudden horizontal changes appearing as warm and cold fronts. Considering the two systems analogous, the dynamic behaviour explains several phenomena and fits to plate tectonic reconstructions.

The geological evolution of the front system (e.g. DOGLIONI et al. 1999, KUHLEMANN 2000) is ambivalent: the Alpine flank (representing the warm front) is moving relatively slowly towards N with slightly rotating trend and with decreasing rate, while the fast moving and accelerating Apenninic flank introduces rotation: Corsica and Sardinia are the first testimonies and in the last 10 Ma the fast opening of the Tyrrhenian basin shows similar characteristics to meteorological cold fronts.

The fact that earthquake distribution of the geoveortex center is very similar to the cloud pattern of an occluded cyclone demonstrates that the process can be validated even in recent times on short timescales as well.

Although the physical background of the phenomenon is difficult to discuss at the present level of knowledge, some basic properties can be mentioned. The meteorological thermal instability (hot and less dense material below, cooled and more dense material on the top) exists also in the mantle, while the non-dimensional scaling is similar, if we take into account the different viscosity and moving speeds. It seems that the cyclonal development also influences the rheological pattern in details: the spatial distribution of the earthquakes suggests, that like in the case of the cloud production in a low pressure zone, the slight differences in p and T in consequence of the mixing of rock masses (analogous to air masses) are responsible for different rheology: some areas produce earthquakes (i.e., at least in part brittle deformation), while some other, horizontally interfingered areas are seismologically more silent indicating ductile deformation.

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