THE MATTERHORN - REALLY FROM AFRICA?

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In the Penninic Alps, ophiolites of the Ligurian ocean occur in two structural units, the lower one being the Zermatt-Saas zone, the higher one the Tsaté nappe. Whereas the Zermatt-Saas unit was subjected to eclogite-facies metamorphism and locally contains coesite, the Tsaté nappe only suffered greenschist- to lower blueschist-facies conditions. The Ligurian ophiolites are overlain by continental basement of the Dent Blanche-Sesia nappe (DS) whose rocks are building up the Matterhorn. Argand (1909, Bull. Lab. Géol., Géogr. etc. Univ. Lausanne, 14, 1-64) attributed the DS to the Penninic domain, but later it became common practice to regard the DS as an Austroalpine nappe to the Apulian ("African") continental margin.

The contact between the Zermatt-Saas and the Tsaté ophiolites is a mylonitic shear zone known under the name of "Combin normal fault" (CNF; Ballèvre & Merle, 1993, Schweiz. Min. Petrogr. Mitt., 73, 205-227). The exhumation of the Zermatt-Saas eclogites is explained by top-to-the-southeast shearing along this fault. The contact between the ophiolitic units is accompanied by a thin layer of Mesozoic sediments that were sheared off from continental crust and now constitute the Cimes Blanches nappe.

The results of microstructural and textural studies (with the neutron texture diffractometre SV7-b, Forschungszentrum Jülich) of mylonitic quartzites derived from this unit substantiate top-to-the-northwest thrusting along the "CNF" predating the top-to-the-southeast movements. For the latter, the nappe stack geometry at the northern end of the "CNF" precludes any amount of displacement greater than 10 km. Hence, the "CNF" is essentially a top-to-the-northwest thrust (see also Ring, 1995, Geol. Rundsch. 84, 843-859).

Based on these observation, we propose the following kinematic reconstruction of the above-described units: The DS units originally formed an intraoceanic continental fragment within the Ligurian ocean, comparable to the Jan Mayen ridge and the Seychelles. The Tsaté and Zermatt-Saas nappes derive from the oceanic domains situated southeast and northwest of the DS, respectively. The Tsaté nappe was thrust over the DS onto the Zermatt-Saas ophiolite. In this process the sedimentary cover of the DS was detached and involved into the Combin fault as the Cimes Blanches nappe. Prior to these processes, the Zermatt-Saas ophiolites had already been subducted southeastward below the DS and partly exhumed again. Along an out-of-sequence thrust the DS overrode the previously higher Tsaté nappe - so that today the Matterhorn represents the highest part of the nappe pile.