

**Zeitschrift:** Bulletin für angewandte Geologie  
**Herausgeber:** Schweizerische Vereinigung der Petroleum-Geologen und –Ingenieure;  
Schweizerische Fachgruppe für Ingenieur-Geologie  
**Band:** 13 (2008)  
**Heft:** 2

**Artikel:** The African Mattherhorn : yes or no? : A structural, geodynamical and  
paleogeographical overview  
**Autor:** Marthaler, Michel  
**DOI:** <https://doi.org/10.5169/seals-226680>

### **Nutzungsbedingungen**

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. [Mehr erfahren](#)

### **Conditions d'utilisation**

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. [En savoir plus](#)

### **Terms of use**

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. [Find out more](#)

**Download PDF:** 01.05.2026

**ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>**

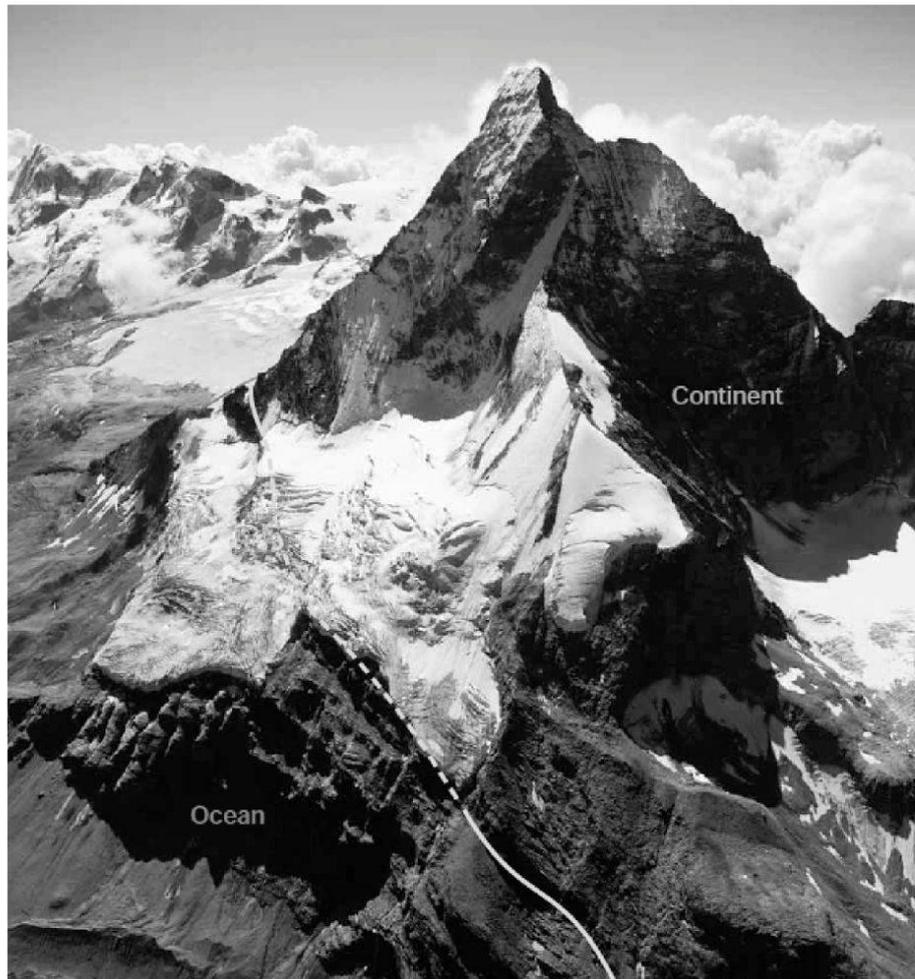
## The African Matterhorn: yes or no? – a structural, geodynamical and paleogeographical overview Michel Marthaler<sup>1</sup>

Summary of a presentation given at the VSP/ASP annual convention, Sion, Switzerland, June 2008.

The geological landscape in the Zermatt Region shows that the pyramid of the Matterhorn appears as a small continental raft run aground on strata of marine sediments, witness of a long vanished ocean (Fig. 1).

On the block diagram (Fig. 2), a schematic three-dimensional view of the Alpine structure, the high Alps of Valais are now no more

than a klippe (the Dent Blanche nappe), a small remnant of the Lower Austro-Alpine unit, from Apulian (or Adriatic) origin. These Klippen are underlain (dark grey) by the Tsaté and Zermatt Nappes (Upper Penninic), both from oceanic origin (Piemont Ocean). Below (in light grey), refolded with Tsaté, the Middle Penninic nappes of Briançonnais



**Fig. 1:** Aerial view of the Matterhorn from north [source: Marthaler 2005].

<sup>1</sup> Université de Lausanne, Faculté des Géosciences et de l'Environnement, Institut de géographie, CH-1015 Lausanne, Suisse

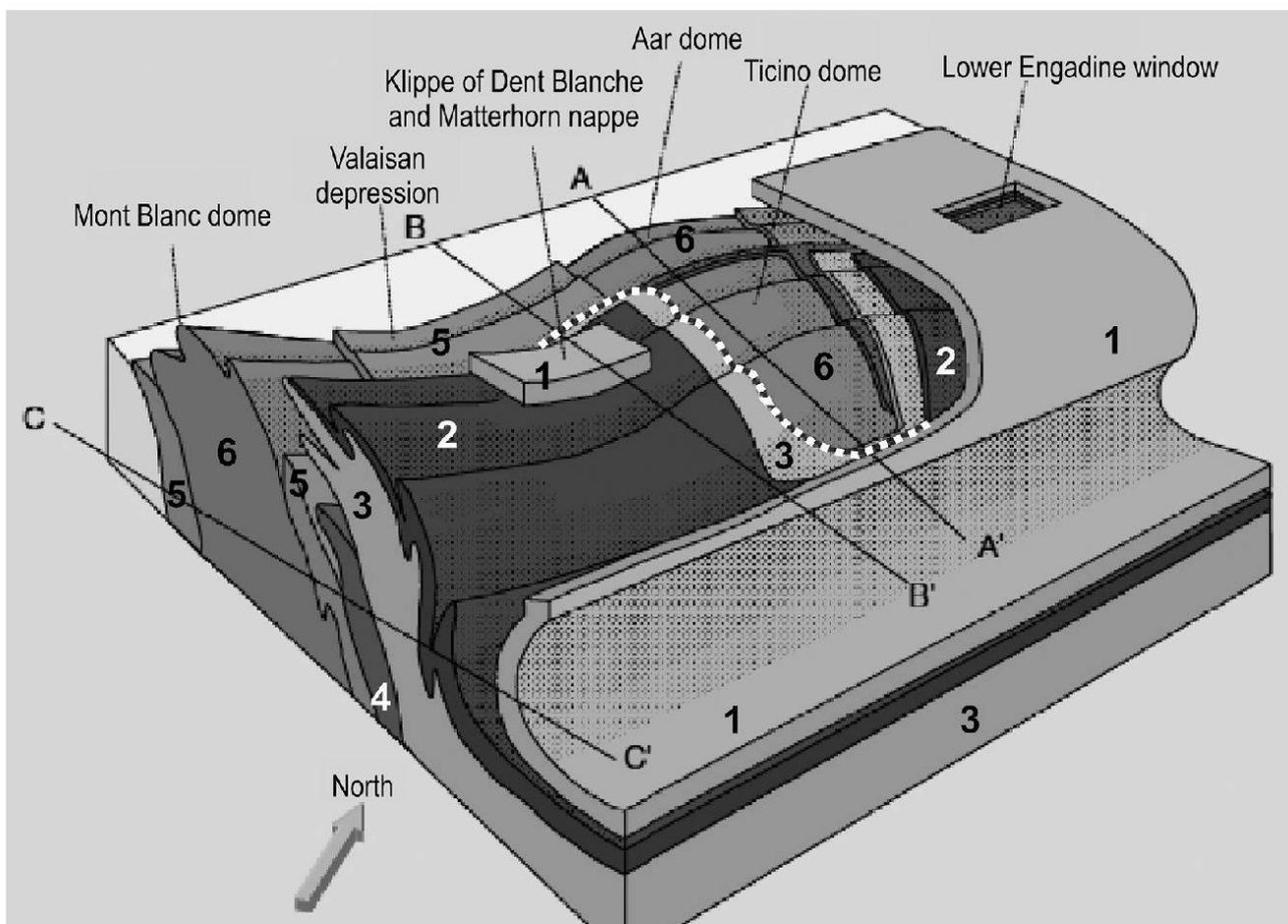
origin, representing a mostly shallower marine environment underlain by continental crust.

This superposition is beautifully visible from the Gornergrat (Fig. 3, 4). Structurally from base to the top: The basement rocks of Briançonnais origin (continental lower plate, here the Monte Rosa and Lyskamm) are dipping west under a sequence of serpentinite and ophiolite, representing the oceanic crust (here Breithorn and Little Matterhorn). More in the western direction, the Dent Blanche nappe (klippe of continental

upper plate) forms the high peaks of the Valaisan Alps, from the Matterhorn to the Weisshorn.

The cross-section from SE to NW (Escher et al. 1997) in Fig. 5 shows the three main units in greater details.

The history of the alpine orogenic cycle is related to the evolution of the Tethys and its later deformation by the closing-in of Africa against Europe. The Tethys oceanisation started at early Jurassic times (Fig. 6A). Between Europe and Northern Africa (Apu-



**Fig. 2:** In this simplified block diagram, adapted from Burri [1992], back folds have not been drawn. Note the longitudinal curvature of the forward folds, giving rise to the preservation of sediments of the Helvetic nappes in the Valaisan depression, whereas in the massifs of Mont Blanc and Aar updoming continental crust is exposed at surface. The strongly uplifted Ticino dome has laid bare the European bedrock. The overlying pile of Penninic and Austro-alpine nappes have been entirely eroded away. These nappes are still conserved in the Eastern Alps (Austria and the Engadine Valley) and in central parts of the Valais. The high Alps of the Canton Valais are representing a Klippe (known as the Dent Blanche nappe, out of which the Matterhorn itself is carved), a small remnant of an Austro-alpine unit from the northern edge of the Apulian plate, that was once much larger than it is at present. [1] Austro-alpine nappes, [2] upper Penninic nappes, [3] middle Penninic nappes, [4] metasedimentary, lower Penninic nappes, [5] Helvetic nappes, [6] external crystalline massif and lower Penninic nappes; Simplicon fault (dotted line).

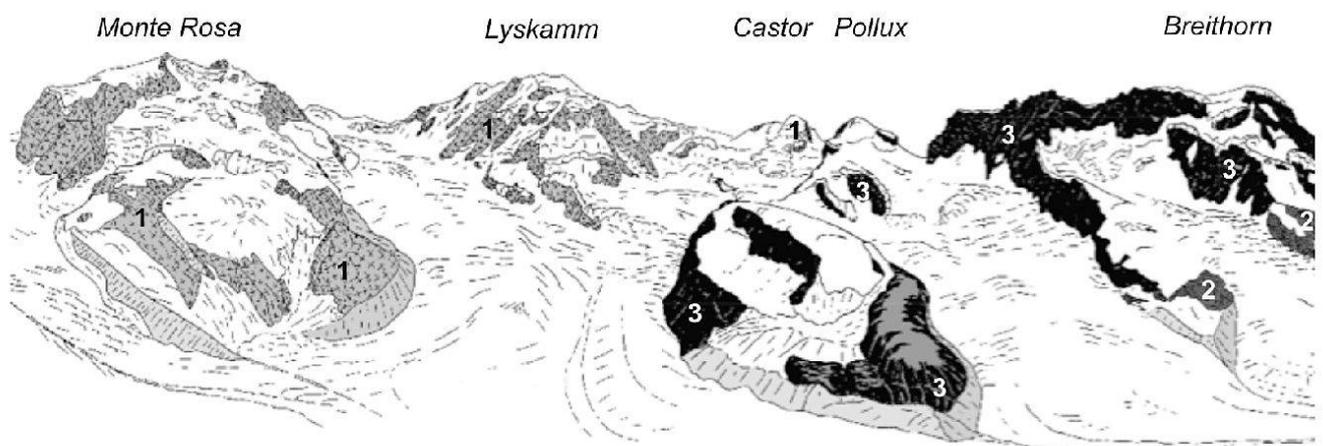
lia), the Piemont Ocean is opening thanks to the spreading of a very active mid-oceanic ridge. In Zermatt we can observe pillow lava, nicely demonstrating the oceanic nature of this crust. The Jurassic pillow shape is well preserved in spite of an overprint by an early Tertiary metamorphism.

During Cretaceous times, the tectonic regime changed from the opening of the Tethys to a progressive closing, initiating the Alpine orogenic event (Fig. 6B). The southern margin is becoming active, with oceanic subduction under Apulia. An accretionary prism is building, witness of the vanished ocean (today the Tsaté and Zermatt nappes). The separation of the Briançonnais from the European continent lasted until early Tertiary when, with the continuous

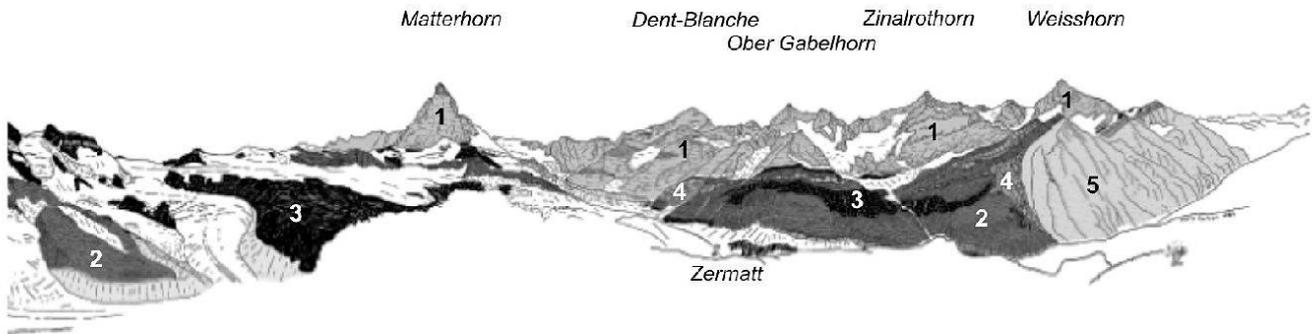
shortening of the northern Valaisan Trough, the subduction became continental, as testified by the high pressure metamorphism of part of the Briançonnais (the Monte Rosa in particular). The landscape of the Moiry region (Fig. 7) illustrates this development in a masterly way.

The emplacement of the Matterhorn Klippe, representing Apulian/African continental crust, on the underlying oceanic crust of the Piemont Trough, occurred during late Oligocene.

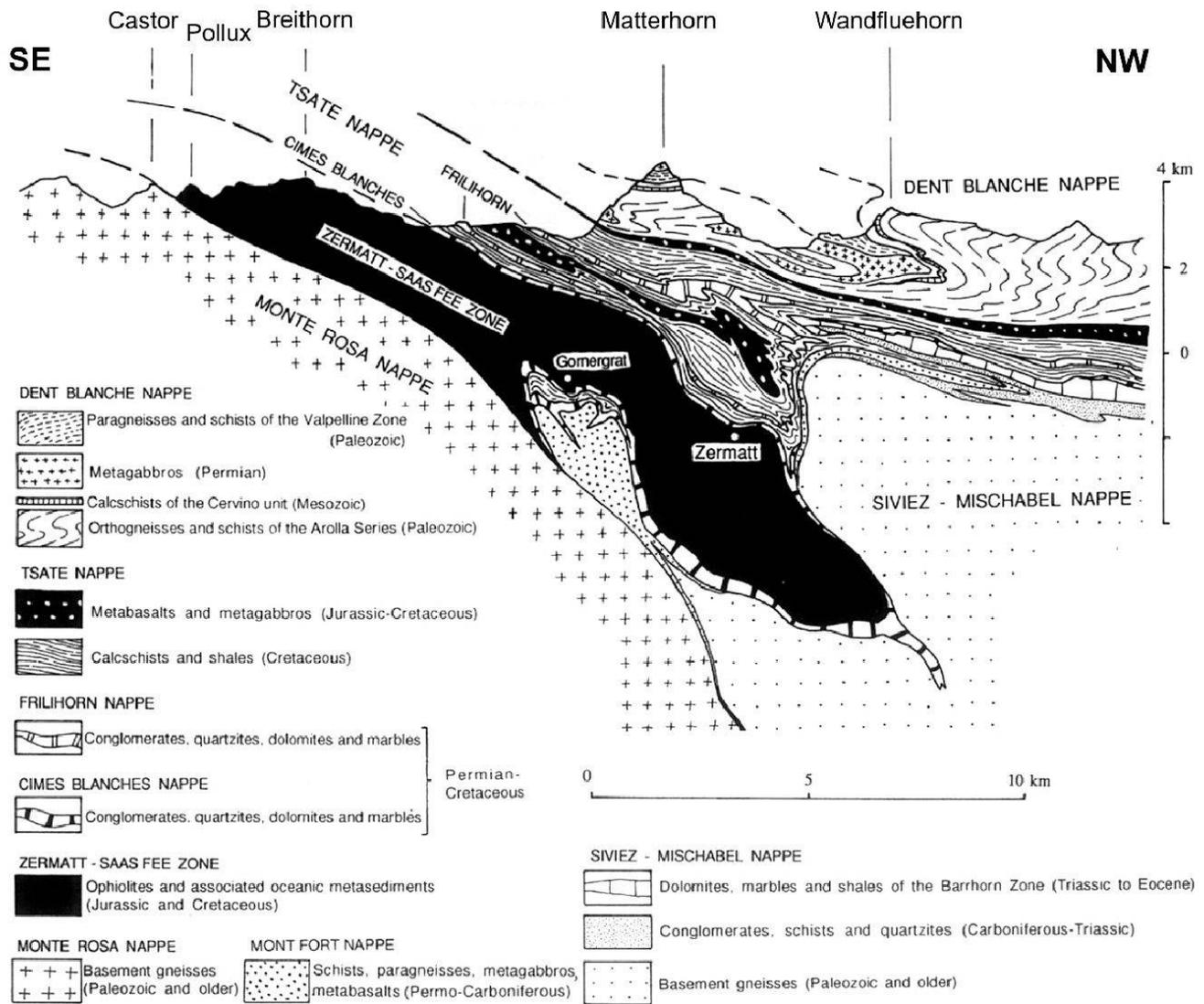
The African Matterhorn: yes or no? – The answer is double: Yes for the rocks, no for the shape. The cause of this change is the plate tectonic history of the Alps.



**Fig. 3:** Panorama from the Gornergrat, drawn by M. Sartori, Departement of Geology and Paleontology, University of Geneva. A view on two continents and the remains of a vanished ocean. [1] Briançonnais basement: granites, gneisses [Protero-Paleozoic]; [2] Oceanic metasediments: mainly calcareous schists [Jurassic-Cretaceous]; [3] Oceanic crust (ophiolite): metabasalts, metagabbros, serpentinites [Jurassic]. Tectonic setting: [1] Monte Rosa nappe, [2/3] Zermatt - Saas Fee Zone.

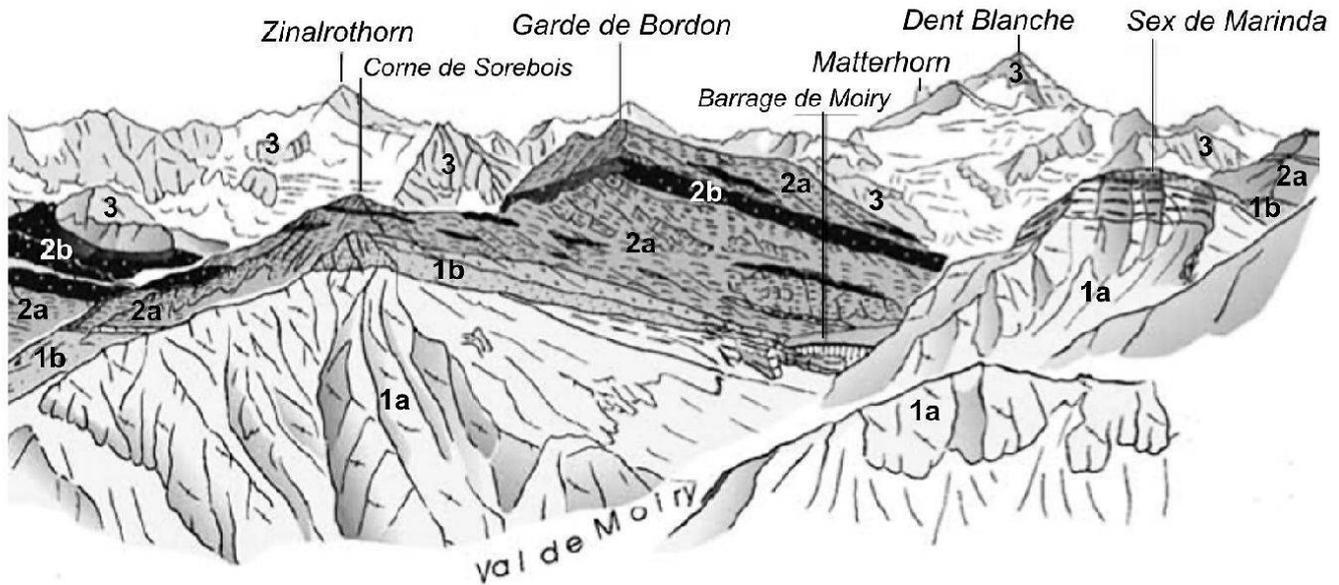


**Fig. 4:** Panorama from the Gornergrat, continued from Fig. 3. [1] Austro-alpine basement: granitic gneisses, gneisses and metagabbros [Paleozoic]; [2] Oceanic metasediments: mainly calcareous schists [«Schistes lustrés»] [Jurassic-Cretaceous]; [3] Scraps of oceanic crust: metabasalts, metagabbros [Jurassic]; [4] Sediments from the Briançonnais platform: quartzites, dolomites, marbles [Permian to Tertiary]; [5] Briançonnais basement: granites, gneisses [Protero-Paleozoic]. Tectonic setting: [1] Dent-Blanche nappe, [2/3] Tsaté nappe or Combin Zone, [4/5] Siviez-Mischabel nappe.



**Fig. 5:** Simplified geological cross-section showing the relation between the Monte-Rosa, Siviez-Mischabel, Zermatt-Saas Fee, Tsaté and Dent Blanche nappes in the Zermatt region [Escher et al. 1997].





**Fig. 7:** The continent-ocean-continent superposition: a fundamental feature of high-Alpine landscapes in Canton Valais. Same superposition as shown in Fig. 4, but from NW. [1] Paleozoic gneisses of the Apulian continental crust (Dent Blanche nappe); [2a] Cretaceous schists: Piemont oceanic metasediments (Tsaté nappe); [2b] Jurassic ophiolites, scrapped oceanic crust (Tsaté nappe); [3a] Paleozoic gneisses, micaschists and amphibolites of the Briançonnais continental margin (Siviez-Mischabel nappe); [3b] Permo-triassic quartzites: continental sediments of the Briançonnais margin. Tectonic setting: [1] Apulia, old african continent, [2] remnants of a vanished ocean, accretionary prism, [3] Iberia, European continent. Panorama drawn by M. Sartori, Departement of Geology and Paleontology, University of Geneva.

## References

- Burri, M. 1992: Die Gesteine. Erkenne die Natur im Wallis. Pillet, St. Maurice.
- Escher, A., Masson, H., Steck, A., Epard, J.-L., Marchant, R., Marthaler, M., Sartori, M. & Venturini, G. 1997: Geologic framework and structural evolution of the Western Swiss-Italian Alps. In: Deep structure of the Alps – Results from NFP 20. Birkhäuser Verlag, Basel. 205-222.
- Marthaler, M. 2005: The Alps and our Planet. The African Matterhorn: a Geological Story. Editions LEP, Le Mont sur Lausanne.
- Stampfli, G.-M. 1993: Le Briançonnais, terrain exotique dans les Alpes? *Eclogae geol. Helv.* 86/1, 1-45.
- Stampfli, G.-M., Mosar, J., Marchant, R., Marquer, D., Baudin, T. & Borel, G. 1998: Subduction and obduction processes in the Western Alps. *Tectonophysics*, 296, 159-204.