Brief description of recent changes applied in November 2006 to the Tectonic map of the Alps as published by Schmid et al. 2004

1. Easternmost Eastern Alps between Graz and Vienna

Some of these changes were necessitated because of graphical errors. Others are the result of considerations regarding grade of metamorphism, which were made in the context of publishing a new metamorphic map of the Alps (Oberhänsli et al. 2004).
The changes show that units, which are part of the Koralpe-Wölz high-pressure nappe system, are more widespread in the easternmost parts of the Eastern Alps. Also units attributed to the Lower Austroalpine nappes (Wechsel nappe and closely related units) are more widespread. At the eastern margin of the Alps also the Semmering nappe (with the exclusion of the Grobgneiss nappe) was taken as part of the Lower Austroalpine nappe system.

2. Austroalpine units to the south of the Tauern Window

According to Fuchs & Linner (2006) an area to the south of the Tauern Window, which had been part of the Koralpe-Wölz high-pressure nappe system in the former version, is now attributed to the Lower Austroalpine nappes. The conclusions of these authors are based on mapping of the Sadnig mountains. Their Zaneberg-, Sadnig and Melenkopf series belongs to the Lower Austroalpine nappes.

3. The paleogeographic and tectonic position of the Schlieren- and Gurnigel-Flysch units at the northern margin of the Alps in Switzerland

The attribution of these units was changed from “South Penninic” (Upper Penninic nappes, unit Nr. 26) to “North Penninic” (Lower Penninic nappes, unit Nr. 32) in the light of new findings regarding the Iberg klippen and underlying flysch units (Trümpy 2006) which question the “classical” view (Caron et al. 1989) that these units, presently found at the northern margin of the Swiss Alps, are of South Penninic (=Piemont-Liguria) origin. However, the debate regarding the paleogeographic origin of these units is still open, and we chose this option primarily for tectonic reasons. The new attribution is more consistent with the eastern continuation of these flysch units at the northern margin of the Alps in the form of the Rhenodanubian flysch, whose position is indisputably North-Penninic.

4. Attribution of the “Piz-Terri-Bündnerschiefer” to “Mesozoic cover of Sub-Penninic basement nappes (unit 33)

North of the Adula nappe, the so-called Piz-Terri-Bündnerschiefer are exposed in the core of an antiform (Lunschania antiform). This fold deforms the former basal thrust of the North-Penninic Bündnerschiefer (with the “Grava unit” at its base). Since the Piz Terri Bündnerschiefer are found in the footwall of this folded thrust, their position is comparable to that of the Bündnerschiefer of, for example, the Bedretto valley (also mapped as Sub-Penninic). Moreover, these Bündnerschiefer are believed to have been deposited on a substratum of continental origin (so-called Soja-nappe).

5. Corrections regarding the Domodossola area

These corrections are mainly based on the findings of Keller et al. (2006) and yet unpublished fieldwork by M. Tischler in 2005.

The Simplon line is no longer connected with the Insubric line via Centovalli-line, since Keller et al (2006) convincingly argue that the Simplon normal fault dies out eastwards, the movements across this normal fault being transformed due to rotations and contemporaneous folding. The Centovalli fault represents a later brittle feature of relatively minor importance, and was hence omitted.

The mapping by Tischler, addressing the eastern continuation of the Vanzone antiform, showed that the Isorno series cannot be connected with the Orselina series, as is depicted in all tectonic maps, including that of Steck et al. (1999). This makes it highly probable that the Orselina Series can be directly connected westwards and across the Valle d'Ossola with the Antrona ophiolites. Hence, we attributed the Isorno Series to the Antrona ophiolites (part of unit 32 "North Penninic ophioloites and Bündnerschiefer") in Val Bognanco. The Antrona ophiolites of Valle Antrona, located south of the Vanzone antiform, are traced westwards directly into the ophiolites and Bündnerschiefer of the Orselina Zone (including the ophiolites at Monte Ziccher) in our modified version. Due to additional modifications, mainly based on the work by Wieland (1966), the Wandfluhorn-fold now appears more clearly as an important mega-structure in the modified version of the map.

6. Corrections regarding high-pressure units at the base of the Maggia nappe

According to the work of Burri (2005) and Berger (oral communication) relics of former eclogites are found in gneissic units which directly underlie the Maggia nappe. These have also been mapped in Oberhänsli et al. (2004). We now only attributed some of these eclogites (not all of them!) to unit 35 (Eclogitic Sub-Penninic basement units), since some of them are probably part of unit 32 (North-Penninic ophiolkites and Bündnerschiefer). This way the synformal position of the Maggia unit at its eastern termination, where it overlies eclogites of units 35, becomes more obvious.

Literature

Burri, T. (2005). From high-pressure to migmatisation: on the orogenic evolution of the Southern Lepontine (Central Alps of Switzerland/Italy). PhD Bern University.

Caron, Ch., Homewood, P. & Wildi, W. (1989). The original Swiss flysch: a reappraisal of the type deposits in the Swiss Prealps. Earth-Science Reviews 26, 1-45.

Fuchs, G. & Linner, M. (2005): Die geologische Karte der Sadnig-Gruppe: Ostalpines Kristallin in Beziehung zur Matreier Zone. - Jb. Geol. B.-A., 145/3+4: 293-301.

Keller, L. M., Fügenschuh, B., Hess, M., Schneider, B. & Schmid, S.M. 2006: Simplon fault zone in the western and central Alps: Mechanism of Neogene faulting and folding revisited. Geology 34/4, 317–320.

Oberhänsli, R., Bousquet, R., Engi, M., Goffé, B., Gosso, G., Handy, M., Höck, V., Koller, F., Lardeaux, J.-M., Polino, R., Rossi, P., Schuster, R., Schwarz, S., Spalla, M. I. (2004). Metamorphic structure of the Alps (1:1'000'000), Commission for the Geological Map of the World (UNESCO), Paris.

STECK, A., BIGIOGGERO, B., DAL PIAZ G.V., ESCHER A., MARTINOTTI, G. & MASSON, H. 1999: Carte tectonique des Alpes de Suisse occidentale et des regions avoisinantes 1: 100.000. Carte géologique spéciale No. 123. Landeshydrologie und -geologie, Bern, 4 feuilles.

Trümpy, R. (2006). Geologie der Iberger Klippen und ihrer Flysch-Unterlage. Eclogae geol. Helv. 99, 79-121.

Wieland, H. (1966). Zur Geologie und Petrographie der Valle Isorno (Novara). Schweiz. Mineral. Petrogr. Mitt., 46.

Tectonic map of the Alps

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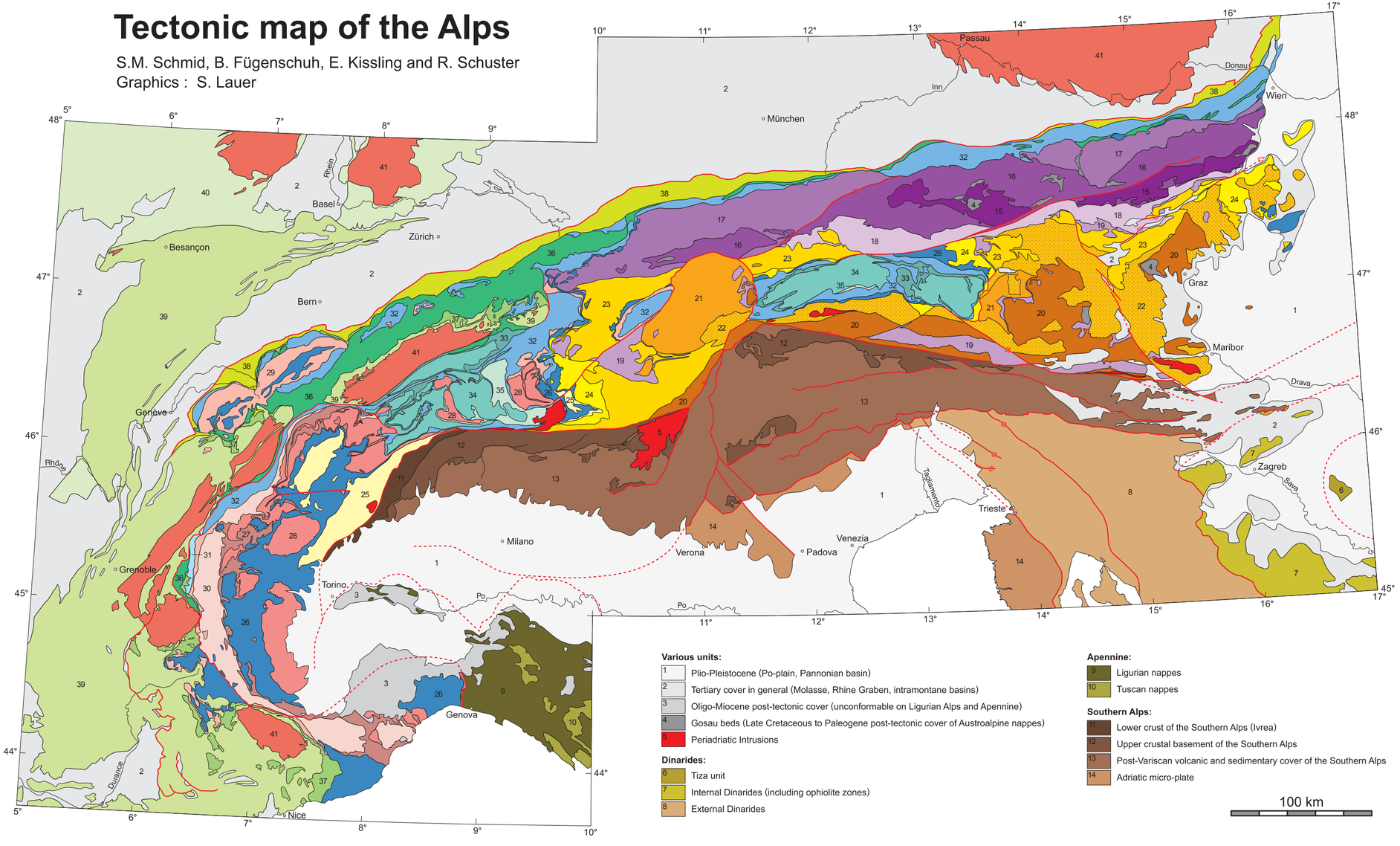
Graphics : S. Lauer



Various units:

- 1 Plio-Pleistocene (Po-plain, Pannonian basin)
- 2 Tertiary cover in general (Molasse, Rhine Graben, intramontane basins)
- 3 Oligo-Miocene post-tectonic cover (unconformable on Ligurian Alps and Apennine)
- 4 Gosau beds (Late Cretaceous to Paleogene post-tectonic cover of Austroalpine nappes)
- 5 Periadriatic Intrusions

Dinarides:

- 6 Tiza unit
- 7 Internal Dinarides (including ophiolite zones)
- 8 External Dinarides

Apennine:

- 9 Ligurian nappes
- 10 Tuscan nappes

Southern Alps:

- 11 Lower crust of the Southern Alps (Ivrea)
- 12 Upper crustal basement of the Southern Alps
- 13 Post-Variscan volcanic and sedimentary cover of the Southern Alps
- 14 Adriatic micro-plate

100 km

Austroalpine Nappes:

Northern Calcareous Alps and Grauwackenzone (Upper Austroalpine):

- 15 Juvavic nappes (Mesozoic cover)
- 16 Tirolian nappes (Mesozoic cover)
- 17 Bavarian nappes (Mesozoic cover)
- 18 Grauwackenzone (Paleozoic, stratigraphic base of Tirolian nappes)

Upper Austroalpine basement nappes:

- 19 Mesozoic cover of Upper Austroalpine basement nappes
- 20 Drauzug-Gurktal nappe system (Tonale series, Steinach nappe, basement of Drauzug, Gurktal nappe, Graz Paleozoic)
- 21 Ötztal-Bundschuh nappe system (Ötztal and Bundschuh nappes)
- 22 Koralpe-Wölz high pressure nappe system (Schneebergzug, Millstatt, Wölz, Saualpe-Koralpe crystalline units)
- 23 Silvretta-Seckau nappe system (Campo-Sesvenna-Silvretta nappes, Innsbrucker Quarzphyllit, Schladming, Seckau, Semmering nappes)

Lower Austroalpine nappes:

- 24 Lower Austroalpine nappes (Ela, Err-Bernina nappes, Radstätter Tauern, Wechsel nappe)
- 25 Nappes derived from Margna-Sesia fragment (Margna-Sella, Sesia-Dent Blanche nappes)

Penninic nappes:

Upper Penninic nappes (Piedmont-Liguria ocean):

- 26 South-Penninic ophiolites, Bündnerschiefer or Schistes Lustrés, Nappes Supérieures des Préalpes, Helminthoid flysch and Matrei mélange

Middle Penninic nappes (Briançonnais terrane):

- 27 Sedimentary cover of Middle Penninic basement nappes
- 28 Middle Penninic basement nappes
- 29 Detached Middle Penninic cover nappes ("Sub-Briançonnais" and "Briançonnais")
- 30 Permo-Carbonifereous sediments (Zone Houllière) and their Mesozoic cover ("Briançonnais")

Lower Penninic nappes (Valais ocean):

- 31 Tertiary flysch sealing Lower Penninic accretionary prism (Cheval Noir Flysch)
- 32 North-Penninic ophiolites and Bündnerschiefer (including Rhenodanubian flysch)

Sub-Penninic nappes (distal European margin):

- 33 Mesozoic cover of Sub-Penninic basement nappes (including cover of "Gotthard Massif")
- 34 Non-eclogitic Sub-Penninic basement nappes (including "Gotthard Massif")
- 35 Eclogitic Sub-Penninic basement units

Northern Alpine foreland and Helvetic nappes:

- 36 Helvetic and Ultrahelvetic nappes (including Combeynot and Tavetsch "Massifs")
- 37 Helvetic flysch
- 38 Subalpine molasse
- 39 Deformed autochthonous and para-autochthonous pre-Teriary cover of the northern Alpine foreland (including the Jura Mountains)
- 40 Undeformed pre-Tertiary cover of the Northern Alpine foreland
- 41 External massifs of the Alps and Variscan basement of the Northern Alpine foreland