Bull. Soc. vaud. Sc. nat. 92.2: 61-75 *ISSN 0037-9603*

Bulletin de Géologie de l'Université de Lausanne n° 368

The Soja and Luzzone-Terri nappes: discovery of a Briançonnais element below the front of the Adula nappe (NE Ticino, Central Alps)

par

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Résumé.–GALSTER F., EPARD J.-L. & MASSON H., 2010. Les nappes de Soja et de Luzzone-Terri: découverte d'un élément Briançonnais sous le front de la nappe de l'Adula (Tessin NE, Alpes centrales). *Bulletin de la Société vaudoise des Sciences naturelles* 92.2: 61-75.
La nappe classique de Soja, située sous le front de l'Adula dans le NE du Tessin, est constituée en réalité de deux unités tectoniques au contenu stratigraphique très différent: (1) La plus petite, dans le Val Soi, est par définition l'unité de *Soja s.str.*. Elle est pincée entre Simano et Adula et comporte des gneiss paléozoïques variés et un Trias dolomitique analogue à celui d'autres nappes penniques inférieures. (2) La seconde, de plus grande extension, longe le Lac de Luzzone et continue vers l'E en passant par le Piz Terri. Nous la nommons *nappe de Luzzone-Terri*. Elle comporte: (a) des paragneiss qui évoquent le Permien de la Zone Houillère en Valais; (b) un Trias typiquement Briançonnais, dans lequel on reconnaît très clairement les Calcaires de St-Triphon (calcaires vermiculés, etc) et les autres grandes subdivisions du Trias Briançonnais; (c) une épaisse série de métapélites et calcschistes noirs d'âge liasique, semblable à la couverture du massif du Gothard. Cette superposition stratigraphique d'une série de type Helvétique sur un Trias Briançonnais est unique dans les Alpes et a de lourdes implications paléogéographiques. Elle est difficile à concilier avec des spéculations récentes selon lesquelles le domaine Briançonnais aurait été situé originellement loin des bassins Helvétiques. Le caractère Briançonnais de son Trias implique en outre que la nappe de Luzzone-Terri a une origine ultra-Adula.

Mots clés: Soja, Luzzone, Piz Terri, Adula, Tessin, Pennique, Trias briançonnais, Alpes centrales

Abstract.–GALSTER F., EPARD J.-L. & MASSON H., 2010. The Soja and Luzzone-Terri nappes: discovery of a Briançonnais element below the front of the Adula nappe (NE Ticino, Central Alps). *Bulletin de la Société vaudoise des Sciences naturelles* 92.2: 61-75.

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CODEN: BSVAA6

The classical Soja nappe, in NE Ticino, actually consists of two distinct tectonic units with very different stratigraphic contents: (1) The smaller one, in the Val Soi (the type-locality), is by definition the *Soja* unit *s.str*.. It is pinched between Simano and Adula and consists of various Paleozoic gneisses and a dolomitic Triassic cover analogous to the Triassic of other Lower Penninic nappes. (2) The larger one extends along the Lago di Luzzone and continues eastwards through the Piz Terri mountain. We name it the *Luzzone-Terri nappe*. It consists of: (a) a paragneiss series that presents striking similarities with the Permian of the Zone Houillère in Valais; (b) a Triassic cover typical of the Briançonnais domain where one clearly recognizes the St-Triphon Formation and other characteristic units of the Briançonnais Triassic; (c) a thick series of black calcschists and metapelites of Liassic age, similar to the cover of the neighbouring Gotthard massif. This stratigraphic superposition of a Liassic series of Helvetic type on a Briançonnais Triassic is unique in the Alps and has important paleogeographic consequences. It is difficult to reconcile this observation with speculative reconstructions that propose an original position of the Briançonnais domain far from the Helvetic basins. Morover the Briançonnais character of its Triassic series indicates an ultra-Adula origin of the Luzzone-Terri nappe.

Keywords: Soja, Luzzone, Piz Terri, Adula, Ticino, Penninic, Briançonnais Triassic, Central Alps

Introduction: Soja and Luzzone, two distinct tectonic elements

The Soja nappe is a small tectonic unit situated below the front of the Adula nappe in NE Ticino. It is classically characterized by a dam- to hm-thick sliver of paragneiss of presumed Late Paleozoic age, partly conglomeratic (sometimes called "Verrucano") (Jenny *et al*. 1923, Frischknecht *et al*. 1923, Baumer 1964, Egli 1966, Probst 1980, Berger *et al*. 2007, Wiederkehr *et al*. 2008). Most authors traditionally consider it as rooted below the Adula nappe. Since the works of Uhr (unpubl.), Kupferschmid (1977) and Probst (1980) it is usually admitted that the Soja gneiss has a sedimentary cover of Triassic to Early Jurassic age that continues eastwards into a complex zone called Piz Terri-Lunschania.

This Soja nappe, in its classical meaning, consists of two segments separated by a 2 km wide landslide SE of Olivone (figure 1):

1.- A southern segment extends over 3.5 km NW of Val Soi (the type-locality) before it disappears below the landslide.

2.- NE of the landslide, the gneiss can be followed over 7.5 km in the slopes S of the Lago di Luzzone and in the Valle di Garzora.

All authors assume that these segments connect (at least virtually) below the landslide.

Stratigraphic and structural analysis based on detailed mapping of both segments, in the gneisses and their Mesozoic covers, reveals that each part is homogeneous in its stratigraphic content, while there are significant differences between the southern and the northern segments, as explained below. Consequently we think that their connection below the landslide is improbable and we consider them as two distinct tectonic elements. The southern element, situated in the type locality, is by definition the *Soja nappe s.str*.. We call the northern element *Luzzone*.

Both elements have the structure of an isoclinal anticline with a Paleozoic core. Mesozoic rocks are well developed in both limbs of the Luzzone element, but only in the normal limb of the Soja nappe *s.str*.

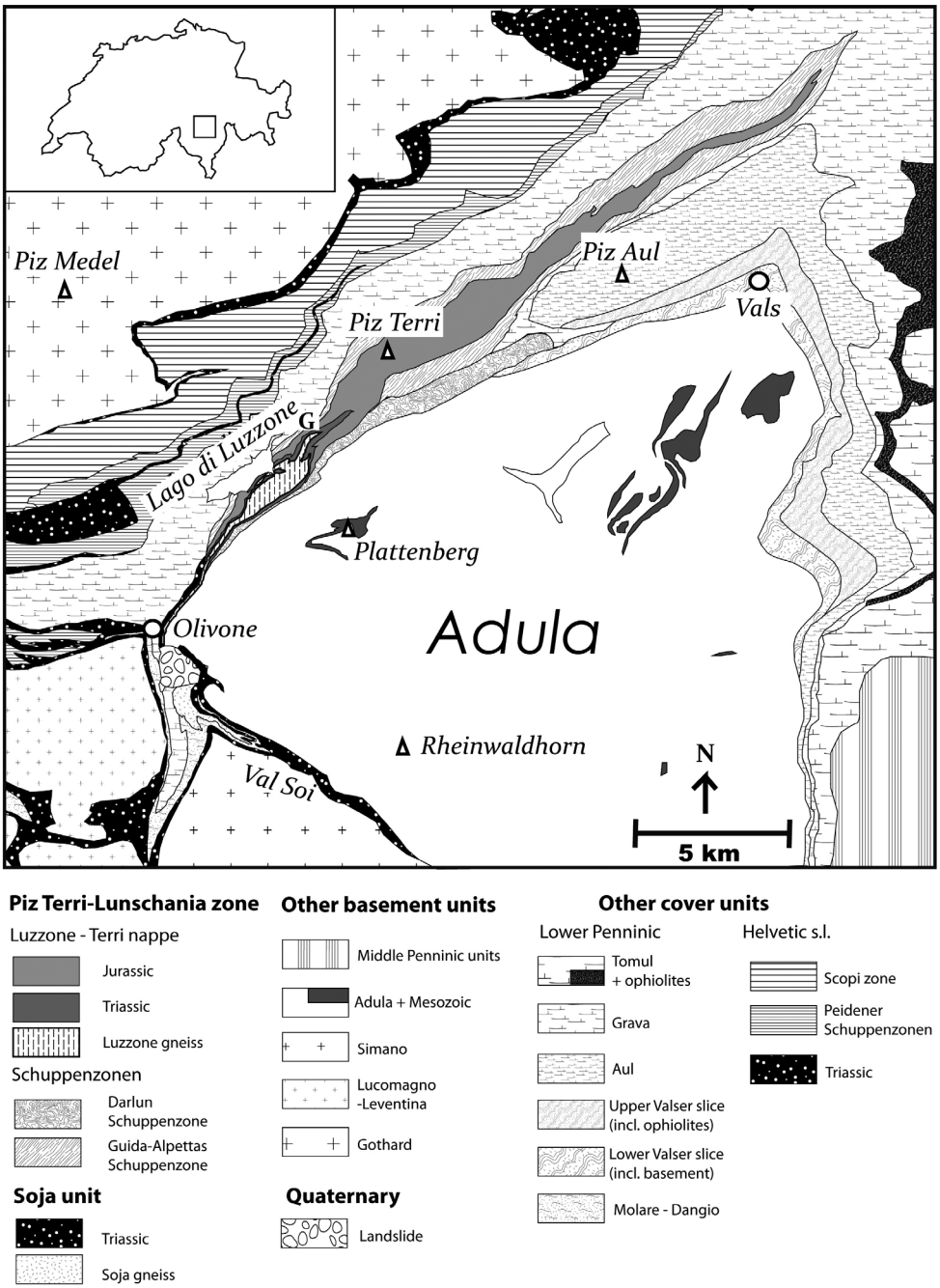

Figure 1.–Tectonic map of the northern Adula nappe and neighbouring units. G: Garzora. After FRISCHKNECHT *et al.* 1923, PROBST 1980, WIEDERKEHR *et al.* 2008 and personal observations.
Carte tectonique de la partie nord de l'Adula et des unités avoisinantes. G: Garzora. D'après FRISCHKNECHT *et al.* 1923, PROBST 1980, WIEDERKEHR *et al.* 2008 et des observations personnelles.

Compared stratigraphy of the Soja and Luzzone elements

1. Old gneiss

The Soja nappe *s.str.* contains an anticlinal core of gneiss with hints of pre-Alpine metamorphism. It has already been distinguished as "Altkristallin" on the map of Frischknecht *et al.* (1923). The Luzzone element shows no evidence of such an old, polymetamorphic gneissic basement.

2. Late Paleozoic paragneiss

This is the characteristic lithology of the classical Soja nappe.

2.1 Luzzone element

The Luzzone paragneiss mainly consists of well-bedded arkosic meta-sandstones and greenish micaschists. Conglomeratic intercalations, with pebbles of quartz or quartzo-feldspathic rocks scattered in the arkose or micaschist matrix, appear mostly near the top of the formation. Dark brown spots of an ankeritic carbonate are omnipresent, particularly abundant in the arkoses. In its upper part this formation may contain thin layers of brown dolomite.

This formation displays definite affinities with the Moosalp Formation, of Permian age, in central Valais (Thélin 1982 p. 33-34, Genier *et al.* 2008). This is a characteristic lithostratigraphic unit of the external part of the Paleozoic Briançonnais paleogeographic domain, or, in tectonic terms, of the lowest tectonic elements of the Grand St-Bernard nappe south of Visp (Zone Houillère and the overlying St-Niklaus syncline). The Luzzone paragneiss passes upwards to a conglomeratic quartzite (with only quartz pebbles in the quartzite matrix) that is similar to some parts of the Late Permian Embd Member in the St-Niklaus syncline (Genier *et al.* 2008).

2.2 Soja nappe s.str.

The general lithology is similar but the Moosalp-type characteristics are less pronounced. It is poorer in carbonates: there is no dolomitic intercalation and the ankeritic spots are less abundant. In the inverse limb of the nappe the stratigraphically upper part is enriched in conglomerates but layers similar to the Embd Member are absent.

3. Triassic

In both units the paragneiss is overlain by a white, pure quartzite (presumed of Early Triassic age) that passes transitionally upwards to a thick series of carbonate rocks. This carbonate sequence differs strongly in the northern and southern elements.

3.1 Luzzone element

The Luzzone carbonate series displays typical characteristics of the Triassic Briançonnais domain. It is particularly well exposed in the normal limb of the nappe from Forcadona (south of the Luzzone dam) to Fanee (east of the lake) where a complete cross-section with very characteristic facies can be observed.

Figure 2.–Vermiculated limestone in the Saint-Triphon Formation (Briançonnais Triassic). Fanee, E of Lago di Luzzone.
Calcaire vermiculé dans la Formation de Saint-Triphon (Trias Briançonnais). Fanee, E du lac de Luzzone.

Figure 3.–Burrows of decapod crustaceans, typical of the Saint-Triphon Limestone, in the Luzzone Triassic. Forcadona, S of the Luzzone dam.
Terriers de crustacés décapodes, typiques du Calcaire de Saint-Triphon, dans le Trias de Luzzone. Forcadona, S du barrage de Luzzone.

Most typical is the Saint-Triphon Formation (Lower to Middle Anisian), characterized by its *calcaires vermiculés* with their specific ichnofossils (figure 2 and 3; Botteron 1961, Baud 1976 and 1987). At Fanee its thickness is about 25 m. The stratigraphic transition from the quartzite to the carbonate sequence is well exposed, with alternating layers of dolomites, quartzites and greenish metapelites underlying a first 3 to 5 m thick bed of yellow dolomite (figure 4). This transition can be convincingly correlated with the base of the Saint-Triphon Limestone (Dorchaux Member) in classical sections of the Prealps. However at Luzzone the upper third of the Saint-Triphon Formation is more dolomitic than in the Prealps or in the French Alps.

A 30 m thick unit of ash-grey, weakly calcareous dolomite overlies it. It is banded at the dm- to m-scale, with intercalations of pale-coloured dolomite, and finely laminated at the mm-scale (figure 5 and 6). This lamination can be present through its whole thickness but is only clearly visible on first quality outcrops. These structures correspond to the sedimentological characteristics of the "Calcaire rubané" or Champcella Formation (Upper Anisian to Lower Ladinian; Mégard-Galli & Baud 1977), although at Luzzone this formation is more dolomitic than in the type locality near Briançon, which implies a higher degree of confinement during sedimentation.

Figure 4.–Base of the Saint-Triphon Limestone Formation (Dorchaux Member): alternating beds of yellow dolomites, greenish metapelites and quartzites between the Lower Triassic white quartzite (on the right in the grass) and the limestone (grey on the left). Fanee, E of Lago di Luzzone.
Base de la Formation des Calcaires de Saint-Triphon (Membre de Dorchaux): alternance de lits de dolomies jaunes, métapélites verdâtres et quartzites, entre le quartzite blanc du Trias inférieur (à droite dans l'herbe) et le calcaire (gris à gauche). Fanee, E du lac de Luzzone.

Figure 5.–Banded dolomite in the Champcella Formation (Briançonnais Triassic). Fanee, E of Lago di Luzzone.
Dolomie rubanée de la Formation de Champcella (Trias Briançonnais). Fanee, E du lac de Luzzone.

Above it, a relatively thin (a few m) layer of intraformational dolomitic breccias (figure 7) corresponds to the Clot-la-Cime Formation, a very characteristic level of the Briançonnais Triassic again (Upper Ladinian to Carnian; Mégard-Galli 1972, Baud & Mégard-Galli 1975). Finally 40 m of uniform, pale yellow dolomites (the "blond dolomite" of Norian age) form the upper part of this carbonate sequence.

All these observations definitely assign the Luzzone Triassic series to the Triassic Briançonnais domain. The whole sequence corresponds from base to top to the stratigraphic column of the Triassic Briançonnais carbonate platform (figure 9), for instance in the Prealps (Préalpes Médianes Rigides nappe, e.g. Genge 1958 and Baud 1972) and in the frontal part

of the Grand St-Bernard nappe in Valais (Triassic cover of the Zone Houillère, Weidmann & Baud *in* Gabus *et al.* 2008), which are well correlated with the type Briançonnais series of the Briançon region and of the Vanoise (Ellenberger 1958, Baud & Mégard-Galli 1975, Mégard-Galli & Baud 1977).

3.2 Soja nappe s.str.

The Soja Triassic is nearly entirely dolomitic, except for a few thin layers of limestone at the base. Several distinct levels of dolomite have been identified with a good lateral continuity. One of them is a bicoloured unit characterized by an alternation of white and cinder-grey or grey-bluish layers. Similar alternations are known in the Triassic of several Lower Penninic nappes. No typical Briançonnais feature has been observed.

4. Jurassic: the Piz Terri Liassic schists

Absent in the Soja nappe *s.str.,* the Jurassic is well developed in both limbs of the Luzzone element as a dam- to hm-thick series of black pelitic schists and calcschists. The two limbs merge into a thick zone of dark schists at the anticlinal closure of the Triassic east of Garzora. This zone goes up onto the wild cliffs of the Piz Terri (figure 8) (Terri-Gipfel-Zone of Kupferschmid 1977 and Probst 1980). All authors ascribe a Liassic age to these rocks, an interpretation with which we agree in spite of the lack of fossils.

Detailed observations confirm the gradual, stratigraphic transition from the Luzzone Triassic to the Terri schists. This transition is clearly visible in the first lateral ravine of the Garzora river below Dolee. It is several m thick and consists first in an alternation of thin layers of dolomites with greenish metapelites, then with whitish micaceous quartzites and brownish dolomitic sandstones. These layers have been correlated by Baumer (1964), Kupferschmid (1977) and Probst (1980) with the Quartenschiefer (top Triassic) of the Gotthard massif. Then the dolomite content decreases gradually upwards and the first beds of carbonate-free black pelites appear, alternating with fine-grained sandstones. It finally passes to very uniform, weakly calcareous black marls.

The stratigraphic nature of this contact is very important because the Briançonnais kinship of the Paleozoic and Triassic Luzzone series completely breaks at the onset of the Jurassic: the affinity of the Liassic series of the Piz Terri is definitely towards the Helvetic paleogeographic domain. This Helvetic affinity is highlighted by the fact that the three classical lithostratigraphic subdivisions of the Liassic sedimentary cover of the neighbouring Gotthard massif (the Stgir, Inferno and Coroi series; Baumer *et al.* 1961, Jung 1963, Frey 1967, Etter 1987, Wyss & Isler 2007) are recognizable in the Terri calcschists and metapelites (figure 8 and 9). The difference between the Gotthard cover and the Terri Liassic sediments consists essentially in a gradual attenuation of the lithostratigraphic contrasts towards the south; it is minor and remains entirely within the variability of the Liassic stratigraphy in the Helvetic (*sensu lato*) domain.

The upper part of the transitional levels described above and the black marls correspond to the basal and lower Stgir series. Higher up, in the (at first sight) very monotonous series of black schists, careful observation reveals the two detrital inputs, of Lotharingian and Domerian age respectively, that characterize a large part of the Helvetic Liassic basins in the Swiss Alps (e.g. Loup 1992). In the Gotthard cover this detrital influence is attenuated

Figure 6.–Finely laminated, ash-grey dolomite at Fanee, E of Lago di Luzzone.
Dolomie cendrée, finement laminée, à Fanee, E du lac de Luzzone.

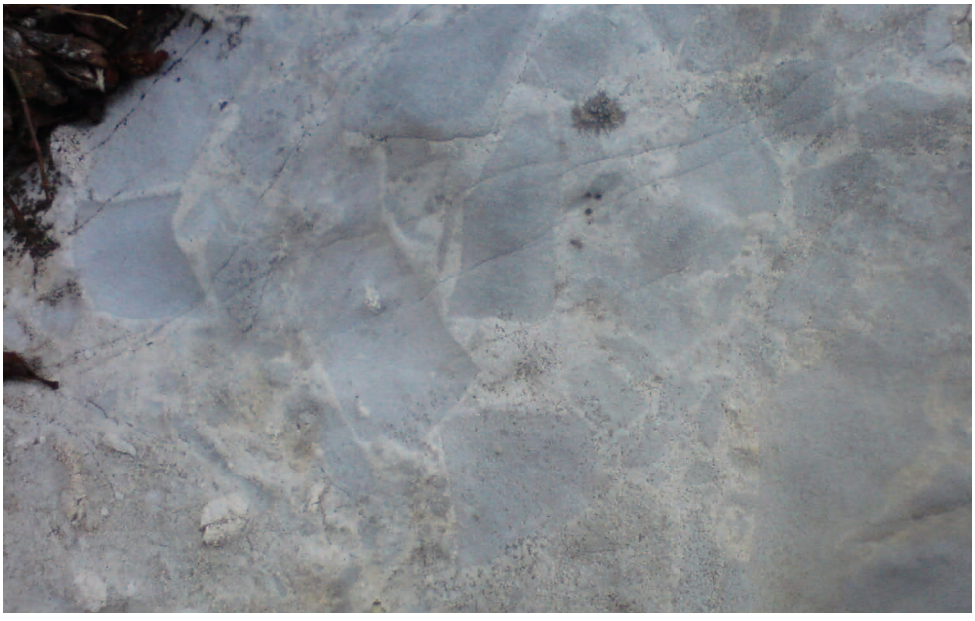

Figure 7.–Intraformational dolomitic breccia (Clot-la-Cime Formation, Carnian). Fanee, E of Lago di Luzzone.
Brèche dolomitique intraformationnelle (Formation de Clot-la-Cime, Carnien). Fanee, E du lac de Luzzone.

but still present: the first one corresponds to the upper Stgir series and the second to the upper Inferno. Both can also be identified in the Terri schists (figure 8 and 9). Between them the calcschists forming the cliffs south and SW of the Piz Terri, which correspond to the lower and middle Inferno series, show gradual vertical and lateral variations with a decreasing calcareous component both towards their base and towards the south. Similar series exist in several "Schuppen" that are thrusted upon the "Terri-Gipfel-Zone" and that also belong to the "Piz Terri-Lunschania zone" of the literature. In one of them a Sinemurian ammonite (*Arnioceras* sp.) was found by Uhr (unpubl.) below the first detrital level, a fact that supports the stratigraphic interpretation.

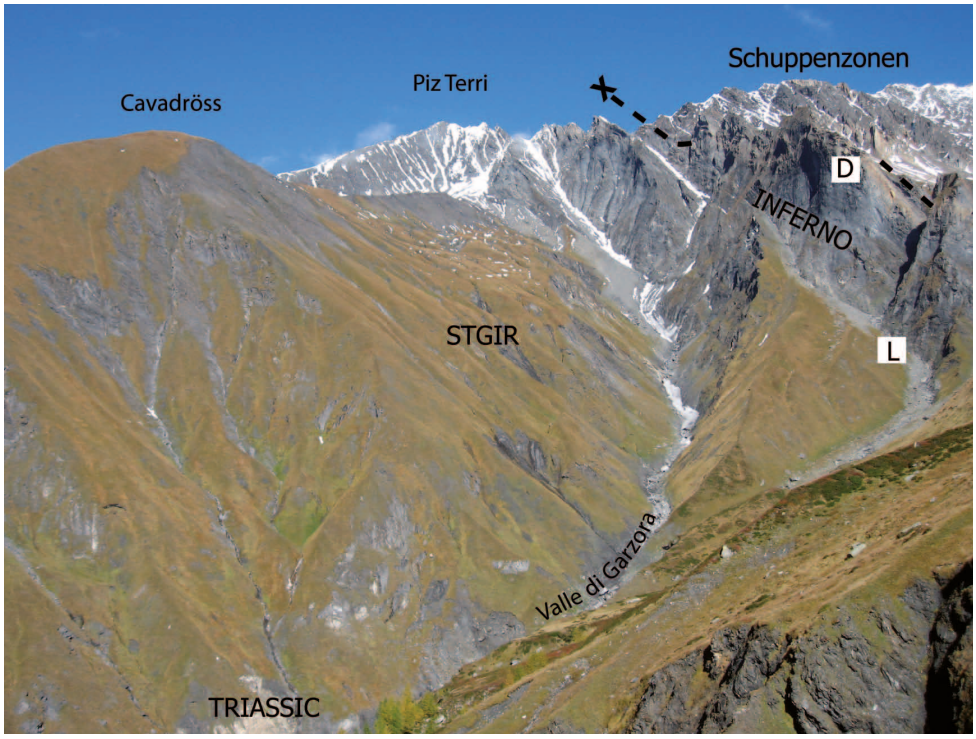

Figure 8.–The Piz Terri seen from Dolee (E of Lago di Luzzone) towards NE. The light-coloured rocks in the bottom of the valley are top Triassic dolomites in the core of the Lunschania anticline. In the thick dark Liassic series overlying them one recognizes the main lithostratigraphic subdivisions defined in the Gotthard sedimentary cover: Stgir, Inferno, and Coroi (the lattest partly hidden behind a cliff). Note the two detrital inputs, characteristic of the Helvetic Lias: the first one (L), of Lotharingian age, corresponding to the upper Stgir, and the second one (D), of Domerian age, to the upper Inferno series.
Le Piz Terri, vu vers le NE depuis Dolee (E du lac de Luzzone). Les roches claires au fond de la vallée sont les dolomies noriennes au cœur de l'anticlinal de Lunschania. On reconnaît dans l'épaisse série Liasique sombre qui les surmonte les principales subdivisions lithostratigraphiques définies dans la couverture du massif du Gothard: Stgir, Inferno et Coroi (cette dernière en partie cachée derrière une falaise). Notez les deux niveaux détritiques caractéristiques du Lias Helvétique: le premier (L), d'âge lotharingien, correspondant à Stgir supérieur, et le second (D), d'âge domérien, à l'Inferno supérieur.

Local complications may appear at several places, for instance in the overturned limb of the nappe east of Lago di Luzzone where breccias reworking clasts of Triassic origin probably record the activity of synsedimentary faults.

We have compared the Piz Terri series with the eastern end of the Gotthard massif for reasons of proximity, but we can emphasize its stratigraphic similarity with more distant sectors of the Helvetic domain as well, as far as the Liassic core of the Morcles nappe in western Switzerland and neighbouring France (Epard 1990). It is only south of the Mont Blanc that gradual changes progressively modify the characteristics of the sedimentary record.

Discussion and conclusions

Soja and Luzzone are two different tectonic units

As stated in the introduction, the differences between the Soja *s.str.* and Luzzone elements are far too great for a tectonic connection to be possible. They belong to two distinct nappes. The Soja nappe *s.str.* may well root below the Adula, in agreement with traditional conceptions. But the Luzzone element has a completely different origin.

The Briançonnais kinship of the Luzzone Paleozoic and Triassic

The most important result of this work is the demonstration of the typically Briançonnais affinity of the Paleozoic-Triassic Luzzone element (figure 9). Particularly in the Triassic, the observed features belong to the core of the definition of the Briançonnais domain *sensu lato* (i.e. including the Subbriançonnais); they closely match the stratigraphic characteristics that are classically used as a tool for paleogeographic correlations along the Alpine arc (Briançonnais, Vanoise, Préalpes Médianes and Grand St-Bernard nappe in central Valais). In the framework of these correlations, it is interesting to note three particularities of the Luzzone Triassic:

- It is thin. The total thickness of the Luzzone carbonate Triassic series is about 100 m, to be compared with the 1000 m of Triassic carbonates in the Prealps and at Briançon (Baud & Mégard-Galli 1975). This can be partly explained by tectonic deformation, but probably not entirely. The good preservation of many sedimentary structures implies a moderate strain, apparently not compatible with a reduction to 10% of the original thickness. The Luzzone element must have been situated in a part of the basin where the sedimentation rate was lower, although at any time the deposits remained essentially similar to those of the main part of the basin. This implies a very uniform paleogeography, with minimal depth variations.

- At several levels the Luzzone Triassic is more dolomitic than the equivalent level in the Prealps or at Briançon. This is particularly noticeable in the upper part of the Saint-Triphon Limestone and in the Champcella Formation.

- Evaporites are absent or scarce. We only observed at rare places thin layers or dykes of cornieule (rauhwacke) that might give indirect hints of the former presence of gypsum. In the type Briançonnais, gypsum and cornieules are abundant at two levels: at the base of

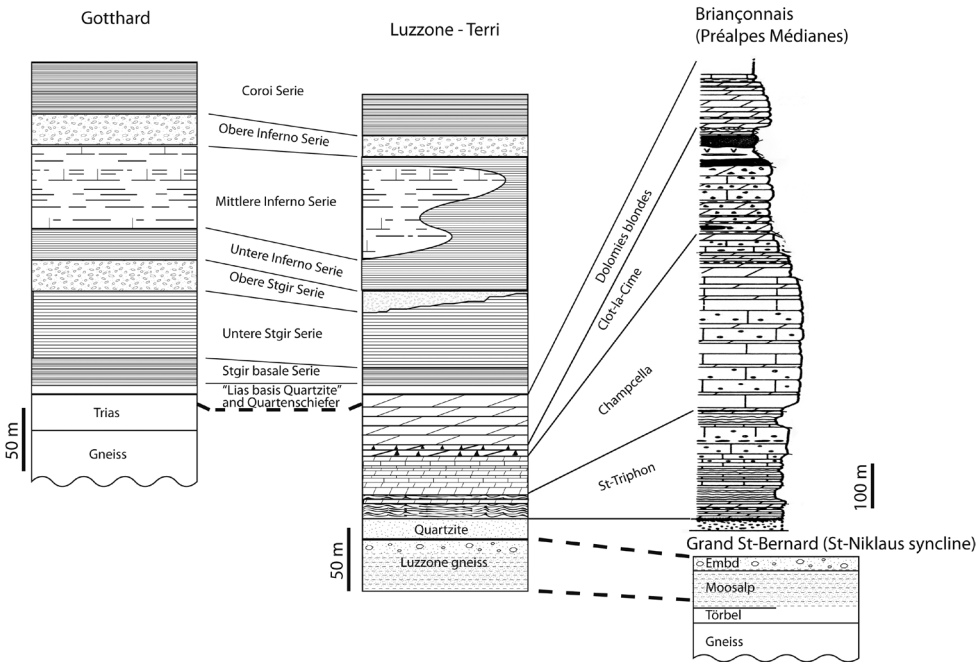

Figure 9.–Stratigraphic column of the Luzzone-Terri nappe, compared with those of the Gotthard sedimentary cover (simplified after BAUMER *et al.* 1961) and of the Briançonnais domain (after BAUD & MÉGARD-GALLI 1975 for the Triassic and GENIER *et al.* 2008 for the Paleozoic).
Colonne stratigraphique de la nappe de Luzzone-Terri, comparée à celles de la couverture sédimentaire du Gothard (simplifiée d'après BAUMER *et al.* 1961) et du domaine Briançonnais (d'après BAUD & MÉGARD-GALLI 1975 pour le Trias et GENIER *et al.* 2008 pour le Paléozoïque).

the Middle Triassic carbonate series, and in the Clot-la-Cime Formation (BAUD & MÉGARD-GALLI 1975). They determine the horizons of décollement and thrusting. At Luzzone their scarcity preserved the coherence of the series.

We infer from these differences that, compared to the Prealps or to the Briançon region, the Luzzone series was situated in a more proximal part of the platform, closer to the external (northern) shore of the Briançonnais Triassic basin (cf. the paleogeographic reconstitutions of BAUD & MÉGARD-GALLI 1975, their figures 3 to 6). The subsidence rate was lower, which probably lead to a slightly shallower sea environment and more confined sedimentary conditions. It is interesting to note that the Triassic of the Zone Houillère in Valais (WEIDMANN & BAUD *in* GABUS *et al.* 2008), which occupies a paleogeographic position more external than the homeland of the Préalpes Médianes Rigides (Subbriançonnais rather than Briançonnais *s.str.*), seems to have intermediate characteristics, in thickness and degree of dolomitisation, between the Prealps and Luzzone. A similar comparison can be drawn with the large Briançonnais Triassic element of the Combe de l'A in western Valais (A. Baud, pers. com.).

The absence of gypsum can be explained the same way. Evaporites characterize times during which the communication of the basin with the open sea was more difficult. The

hypersaline brines must have abandoned the shores of the basin and concentrated in the bottom of depressions along the axis of subsidence (below the global sea level?). A phase of low local sea level in the Briançonnais basin during the Carnian would explain the thinness of the Clot-la-Cime Formation in this external part of the Briançonnais domain.

From a local point of view, the Briançonnais character of the Luzzone Triassic is logical since the underlying Paleozoic has an affinity with the Permian of the Zone Houillère (see above). However it was totally unsuspected before the present study. The consequences are considerable.

Ultra-Adula origin of the Luzzone-Terri nappe

A first consequence concerns the origin or homeland of the Luzzone element. As the Adula Triassic is not Briançonnais (Cavargna-Sani *et al*. 2010), the Luzzone element must have its origin south of the Adula. It must have been translated over it, probably during its subduction, to be finally overtaken by its front when the Adula nappe was exhumed.

An alternative would be to imagine a complex paleogeography, e.g. a bifurcation of the Briançonnais Triassic basin into two branches, one of which would pass north of the Adula. We consider such complications as improbable at the light of the very specific and extremely uniform sedimentary characteristics of this basin (Baud & Mégard-Galli 1975). The uniformity over wide areas and the constantly shallow bathymetry imply a very smooth topography, unfavourable to partitioning or to a complex geometry of the basins. A tectonic explanation of the presence of the Luzzone Triassic north of the Adula is more likely. This problematics is fundamentally the same as that of the klippes, in central Switzerland and at a still larger scale in the Prealps: paleogeographic consistency implies allochthony. The Luzzone element is a klippe of ultra-Adula origin.

However we have seen that the Piz Terri Liassic series is the stratigraphic continuation of the Luzzone Paleozoic-Triassic element. This statement, accepted today by all the authors, is confirmed by our observations (see above). Thus they belong to the same tectonic object. In the literature dealing with this part of the Alps there is a number of terms used for designing "zones", whose definition often mixes stratigraphic and tectonic concepts. None of them exactly corresponds to the tectonic object formed by the Paleozoic Luzzone gneiss (the Soja gneiss being excluded), its Triassic cover and the Liassic rocks of the "Terri-Gipfel-Zone". We propose to name it the *Luzzone-Terri nappe*, associating the names of the gneissic body (ex-northern part of Soja) that forms its core and of the emblematic peak that dominates its Jurassic cover. It is of course the whole Luzzone-Terri nappe that has an ultra-Adula origin.

The Helvetic kinship of the Piz Terri Liassic schists

The Helvetic affinity of the Terri Liassic series is obvious. This is no surprise: several authors already expressed this statement, although in the literature it has never been supported by a detailed stratigraphic comparison. For example we can quote Bolli & Nabholz (1959), about the Piz Terri-Lunschania zone: «Damit zeigen solche Gesteinstypen eine auffällige Analogie zum gotthardmassivischen Lias», or Kupferschmid (1977): «No evidence was found for a separation of the Soja Trough from the Mesozoic depositional basin of the Gotthard massif». In this sentence the word "Soja" must of course be replaced now by "Luzzone".

Combining this statement with the preceding point, this implies that during Liassic times the Helvetic sedimentary conditions extended southwards over the Adula as far as the homeland of the Luzzone-Terri nappe. Note that no Liassic deposit is known in the Adula sedimentary cover; their absence in the Adula record results from the post-Liassic emersion and erosion documented by the recently discovered Plattenberg Breccia (Cavargna-Sani *et al*. 2010).

Helvetic Lias on Briançonnais Triassic: a unique case

The stratigraphic superposition of a Jurassic series of Helvetic type on a typically Briançonnais Triassic is the greatest singularity of the Luzzone-Terri nappe. It is a unique case in the Alps and has major paleogeographic implications. It sets the southernmost extension of the Gotthard-type Liassic basins on a Briançonnais Triassic substratum. Speculative paleogeographic reconstructions that would place the Briançonnais domain at Triassic to Liassic times far from the Helvetic basins are hard to reconcile with this superposition.

No correlation with the Lebendun nappe

The classical Soja nappe is often correlated with the Lebendun nappe in NW Ticino and in the Val Antigorio in Italy. Our observations in both areas show that the similarity of the Lebendun gneiss with the Soja or Luzzone gneisses is superficial (work in progress). The Soja *s.str.* and the Luzzone-Terri nappes have nothing to do with the Lebendun.

Acknowledgements

We thank Alfred Isler (Swisstopo, Bern) for having provided us with a copy of the unpublished manuscript of Albert Uhr, Mattia Cavargna-Sani (Univ. Lausanne) for fruitful collaboration and useful informations on the geology of the Adula, Jean Guex (Univ. Lausanne) for stimulating discussions during which we could benefit from his great experience in stratigraphy, Aymon Baud (Musée de Géologie, Lausanne) whose comments as an expert on the Triassic Briançonnais have been particularly appreciated, and Marc-Henri Derron (Univ. Lausanne) and Alain Morard (Univ. Fribourg) for careful and constructive reviews of the manuscript. We are grateful to the Museo Cantonale di Storia Naturale at Lugano for authorization to collect geological samples in Ticino.

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Manuscrit reçu le 17 octobre 2010