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Lithostratigraphy in crystalline rocks – experiences from the Eastern Alps

SCHUSTER, Ralf, IGLSEDER, Christoph

Geologische Bundesanstalt, Neulinggasse 38, A-1030 Wien, Austria, email: ralf.schuster@geologie.ac.at,
christoph.iglseder@geologie.ac.at

The Alps are one of the orogenic belts that have been studied in detail. It formed since the Early Cretaceous from narrow paleogeographic realms and exhibits a complex tectonic history. Large areas of the Alps have been mapped before modern lithostratigraphy has been established, but until now most of the diagenetic and weakly metamorphosed Mesozoic and Paleozoic successions have been subdivided into lithostratigraphic units properly. In contrast minor amounts of the metamorphic rocks are grouped and formalised in lithodemic units. Experiences from the past 15 years show that the lithodemic nomenclature of the NACSN (2005) is a proper tool for the subdivision of crystalline areas within a young orogenic belt, but there are some aspects which should be mentioned when an earlier traditionally established nomenclature exists:

In general, orogenic belts are characterized by a decrease in metamorphic grade from the internal to the external zones. In former maps of the Eastern Alps tectonic boundaries within the metamorphosed internal zone are shown only in places where slivers of Mesozoic metasediments could be identified between a huge scale of mica schists and paragneisses. The latter were denoted as “Altkristallin” (old crystalline) and thought to represent Variscan consolidated basement. However, modern petrological and geochronological investigations revealed internal metamorphic and lithological discontinuities within the “Altkristallin” implying nappe boundaries between different units. Often these units are indicated by the occurrence of special rock types (e.g., eclogites, different types of orthogneisses) appearing within macroscopically similar metapelites and metapsammites. However, to produce consistent maps these rocks have to be subdivided and grouped in lithodemic units.

Names have to be created for these newly identified units and it has to be decided whether a traditional term (e.g., “Radegund crystalline unit”) is altered or a new one is created. In general, altered traditional terms are accepted rather than new ones, but in addition it has to be proofed if the traditional term has been used in a tectonic or lithostratigraphic sense. There is no rule prohibiting to use the same local term for a tectonic (e.g. Radegund Nappe) or lithostratigraphic unit (e.g. Radegund Lithodeme). However, this should not be the target solution because it may cause confusion.

To state the rank of a lithodemic unit is not always unambiguous. Units mostly include metasedimentary and metaigneous rocks and therefore have to be defined as complexes (“an assemblage or mixture of rocks of two or more genetic classes”, NACSN, 2005). Rarely is it possible to subdivide these complexes completely into lithodemes. For example, most complexes of the Austroalpine Superunit contain marbles. These marbles are present as distinct layers with characteristic features, but also appear as irregular distributed bodies, boudins and tiny patches with variable mineralogical composition and colour. The distinct layers can be formalised as lithodemes but for smaller bodies it is not clear whether they represent one co-genetic lithodemic unit or another.

Furthermore, in many cases distinct formations from the terminal and unmetamorphosed fold and thrust belts are traceable into metamorphosed areas. In these cases the metamorphosed rocks may be part of the same formation or separated from latter as metamorphosed equivalent but individual named units. This problem has been also addressed for Precambrian areas (Easton, 2009). In younger orogenes, like the Alps, intense deformation creates an even more complicated situation, because the distribution of now dispersed formerly continuous layers over several thrust sheets with different metamorphic grade is challenging. Previous experience suggests to separate the metamorphosed rocks from their unmetamorphosed precursor rocks when they are remarkably different or penetratively deformed with (highly) complicated structural relations. For example a formation consisting of shales and limestones at the type locality should not include garnet-mica schists and marbles.

References

EASTON, R.M., 2009: A guide to the application of lithostratigraphic terminology in Precambrian terrains. – *Stratigraphy*, 6/2: 117-134. - NACSN (North American Commission on Stratigraphic Nomenclature): North American Stratigraphic Code (2005). – *AAPG Bulletin*, 89/11: 1547–1591.