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The Err- and Platta-nappes in Central Grisons: a unique place to study how continents break apart and oceans form

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Die Err- und Platta-Decken in Mittelbünden: Ein einzigartiger Platz, um die Prozesse zu studieren wie Kontinente auseinanderbrechen und Ozeane sich bilden

Zusammenfassung

Die südpenninischen Platta- und die ostalpinen Err-Decken, im Gebiet zwischen dem Oberhalbstein und dem Engadin, bestehen aus Relikten eines ehemaligen jurassischen Ozean-Kontinent-Übergangs. Der stratigraphische und strukturelle Aufbau dieses Ozeanrandes lässt sich mit heutigen atlantischen Kontinentalrändern vergleichen und erlaubt Wissenschaftlern die Prozesse, die zur Bildung von Ozeanen führen zu studieren.

Schlagworte: Err- und Platta-Decken, Ozean-Kontinent-Übergang, Platten-Tektonik, Alp Flix, Graubünden

The Lower Austroalpine Err- and the South-Penninе Platta-nappes in Central Grisons preserve remnants of the transition between a former continent (Adria) and the Alpine Tethys Ocean (Fig. 1). This ocean-continent transition was reactivated during Alpine compression and remnants of this transition form today the mountain ridges between Val Surses and the Engadine Valley. The Err- and Platta-nappes preserve one of the world best studied fossil examples of an ocean continent transition and represent therefore a unique geological archive. In present-day oceans the transition between continental and oceanic crusts is located in deep margins, where it is covered by kilometres of sediments and water. Therefore, present-day examples can only be studied either by deep-sea drilling or geophysical surveys, both of which are extremely expensive. The Err- and Platta-nappes constitute therefore a unique natural laboratory to study how continents break apart and oceans form. While the aim of our research is purely academic, the results have direct implications for the survivability of syn- to post-rift petroleum systems in deep margins and have therefore major economic importance. Deep margins represent one of the last frontiers for the hydrocarbon industry. Geologists from all around the world visit the Err- and Platta-nappes to study the rocks and structures that tell us how deep margins formed and continents break apart.

Already in the beginning of the 20th century, Gustav Steinmann concluded that the serpentinites, basalts and gabbros exposed in the Alp Flix area formed remnants of an ancient ocean floor that was covered by radiolarian cherts, interpreted as deep-sea sediments (for more details see Bernoulli et al. 2003). This pioneering interpretation, also known as the «Steinman trinity» was at the origin of the ophiolite concept. Important contributions came also from Cornelius (1932), Stöcklin (1949), Dietrich (1969), Finger (1978) and Trümpy (1975), who mapped, described and interpreted the geology of the Err- and Platta-nappes (see Manatschal and Nievergelt 1997 for more details). These studies formed the basis for a research project that was initiated by Niko Froitzheim back in the eighties. Froitzheim and Eberli (1990) were the first to recognize the existence of pre-Alpine, rift related low-angle detachment faults in the Piz Err-Piz Bial area. Since the early nineties, many Master, Ph.D. and Post Doc projects were conducted and financed by the ETH and the Swiss National Science Foundation and, since 2000, by the University of Strasbourg, the French Margins Program and the hydrocarbon industry. The aim of these projects was to study how continents break apart and oceans form. The various studies investigated the

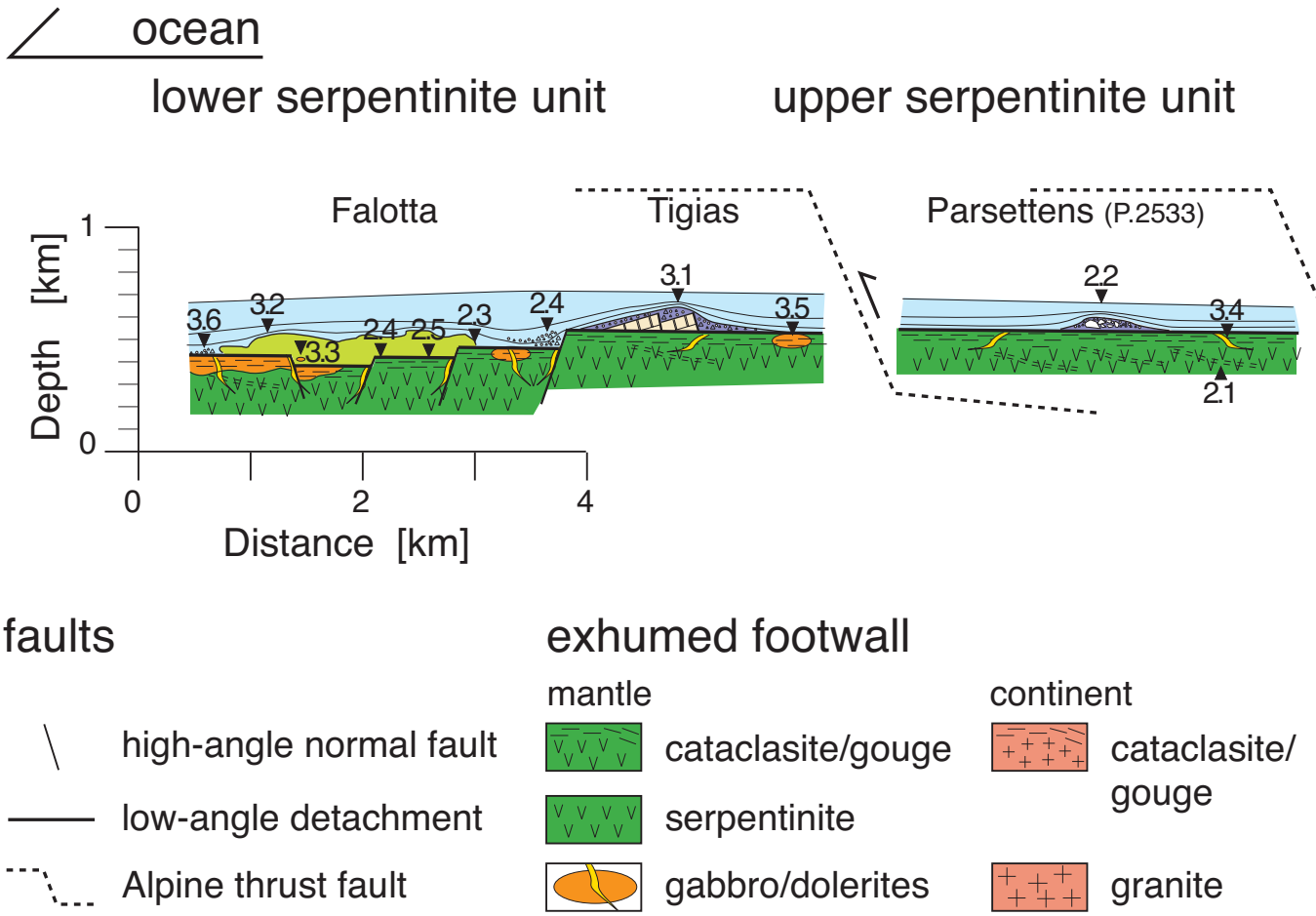
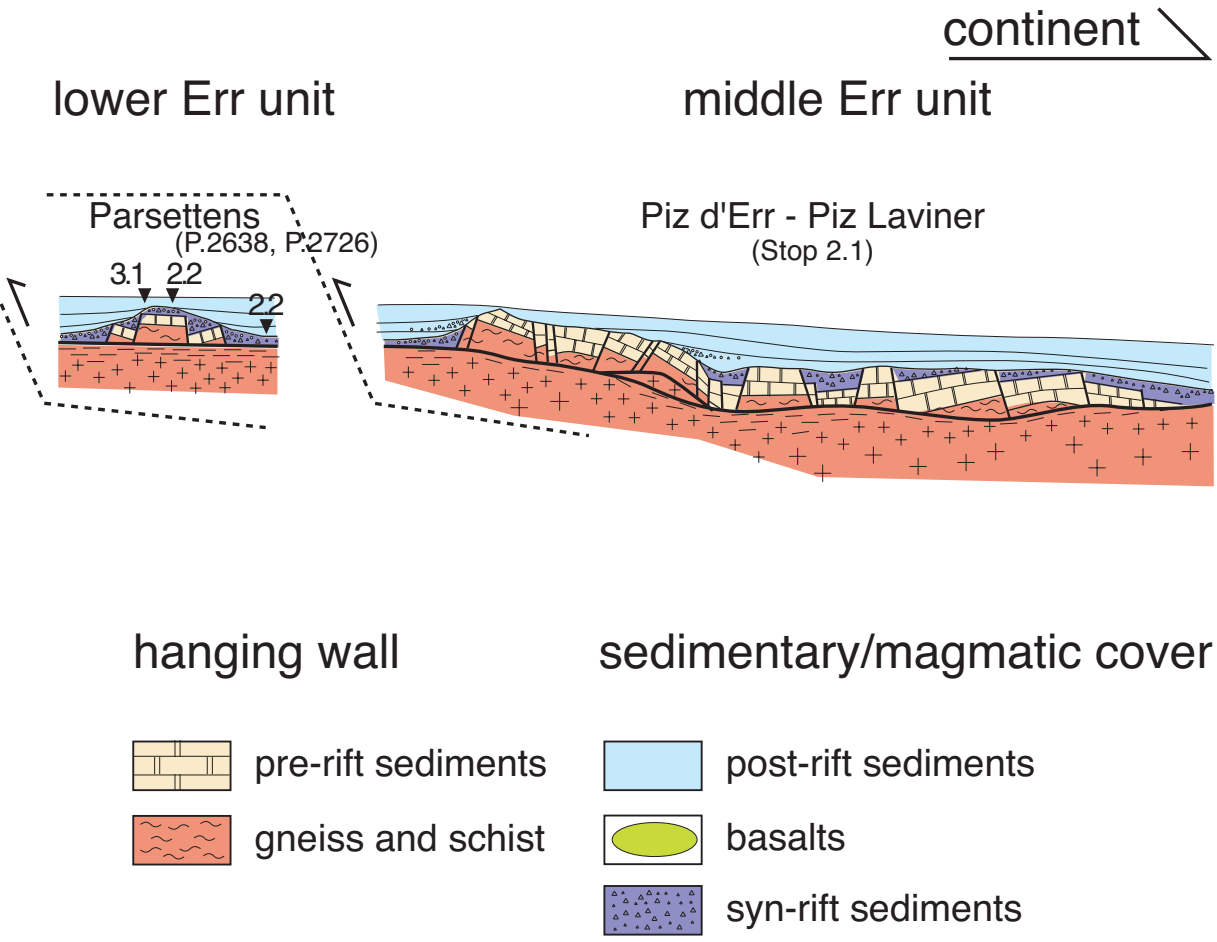


Fig. 1: Palinspastic reconstruction of the Err-Platta ocean-continent transition. Numbers in the figure refer to stops described in a field guide published by Manatschal et al. (2003) (see reference).

petrographic, structural and sedimentological evolution of final rifting and early seafloor spreading. These research projects were carried out in close relationship with studies conducted in the Atlantic Ocean (Ocean Drilling Program) (Whitmarsh et al. 2001) and with numerical modelers (Lavier and Manatschal 2006). These studies made that the Err- and Platta nappes are at present the best described analogues of an ocean continent transition exposed on land. This explains the large international interest, as well as the many international meetings and excursions by scientists and industry people in the last years, as well a large number of scientific publications (for references see Manatschal 2004 and web sites referred below). At present, the research in the Err- and Platta-nappes enters an important phase of major development as indicated by the initiation of three Master and two PhD theses in the last three years. Although the aim of these studies is to understand how continents break apart and oceans form, the results of these projects will result in a better understanding of the regional geology of the Err- and Platta-nappes and ultimately contribute to the understanding of the variability of the bedrock, soil and topography that preconditions the development and variability of the plants and animals in the Alp Flix area.



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2. Links

Die Erdölforscher im Engadin (video)
www.sf.tv/sf1/einstein/index.php?docid=20071018

IODP International Workshop: Investigating Continental Breakup and Sedimentary Basin Formation. Pontresina, Switzerland, September 15–18, 2006
www.iodp.org/continental-breakup

InterMARGINS Workshop: «Modeling the Extensional Deformation of the Lithosphere» (IMEDL 2004), Pontresina, Switzerland. July 11–16, 2004
www.intermargins.org/workshop/workshop2004.php