Due to these results the investigated black sediments can be seen as excellent potential source rocks featuring high potential to generate hydrocarbons in the nappe stack of the Dinarides.

In-sequence and out-of-sequence thrusts: nappe structure of the western Northern Calcareous Alps revisited

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In fold-and-thrust belts, syntectonic sediments provide a means to date deformation. The youngest sediments below a thrust sheet give the maximum age of thrusting, and growth strata record growth of individual structures. Applying this concept shows that the Northern Calcareous Alps (NCA) thrust sheets were emplaced from the Barremian onwards. Thrust activity propagated from the SE to the NW and reached the South Penninic units in the Turonian or Coniacian. Shortening did not cease after thrust sheet emplacement, while the NCA were carried piggy-back over Penninic units. Growth strata in the various Cretaceous syntectonic clastics (Branderfleck Fm., Gosau Group) document significant contraction after thrust sheet emplacement well into the Maastrichtian.

As defined by previous authors, the major thrust sheets of the western NCA are from base to top: The Allgäu thrust sheet, the Lechtal thrust sheet and the Inntal thrust sheet. The first two are part of the Bajuvaric nappe complex, whereas the last belongs to the Tirolic nappe complex. This model of the NCA thrust sheets assumes far-travelled nappes that are entirely separated and have a continuous thrust at their base. If the NCA thrust sheets would adhere to such a simple model the thrusts should display ramp-flat geometry and form a hinterland dipping duplex, which they do not.

Using the information from syntectonic sediments following problems with the traditional nappe subdivision emerge:

(1) The Inntal thrust sheet was emplaced out-of-sequence after thrusting of the Lechtal thrust sheet in its footwall. In the Karwendel mountains, it is connected to the Lechtal thrust sheet in a north-facing anticline dissected by out-of-sequence thrusts. These were originally interpreted to be the base of the Inntal thrust sheet.
(2) The Albian Lechtal thrust ends in a tight anticline in the Arlberg area and is replaced by the Coniacian to Santonian Mohnenfluh thrust.
(3) The Tirolic basal thrust has an Eocene age, where it was drilled (well Vordersee1 east of Salzburg); At the surface, the sinistral Inntal shear zone separates the Bajuvaric Lechtal thrust sheet from the Tirolic nappe complex, and not a flat-lying thrust.

In fact the western NCA are one single tectonic unit. All thrusts end laterally. However, individual thrusts do have offsets in the range reported previously, but thrusts loose offset laterally. In many cases, thrusts do display to out-of-sequence geometries: The Inntal out-of-sequence thrust truncates folds in its footwall and hanging wall, as it should. However, also the Lechtal thrust dissects pre-existing anticlines and synclines. We speculate that only a model of thrust propagation involving significant footwall deformation can describe these thrusts correctly.