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DEFINITION OF THE SILLENKOPF FORMATION IN THE SILLENKOPF BASIN (LATE JURASSIC, NORTHERN CALCAREOUS ALPS)

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The type area of the Sillenkopf Formation (Sillenkopf Basin) is located in the southern Berchtesgaden Calcareous Alps (Tirolicum of the Northern Calcareous Alps, former Staufen-Höllengebirgs nappe; Upper Tirolic unit – FRISCH & GAWLICK 2003).
The carbonate clastic radiolaritic Sillenkopf Basin (Kimmeridgian to Tithonian) in the southern part of the Northern Calareous Alps (Tirolic unit) in the southern part and south of the Lammer Basin contains mass-flow deposits of Late Kimmeridgian age with Pötschen limestones/dolomites, exotic clasts and resedimented shallow-water debris including foraminifers and calcareous algae, mainly dasycladales. The shallow water debris was partly shed from the north (Trattberg Rise) but mostly from the south.

Name of the Sillenkopf Formation: MISSONI, SCHLAGINTWEIT, SUZUKI & GAWLICK 2001.
Derivation of name: Sillenköpfe south of Berchtesgaden (MISSONI et al. 2001, MISSONI 2003).
History: In the type area the cherty sediments with mass-flow deposits were called Sillenkopf Formation by MISSONI et al. (2001). They are dated by MISSONI et al. (2001) and MISSONI (2003) and were originally mapped as radiolarite. DIERSCHE (1980) and BRAUN (1998) mapped them as Tauglboden Formation, because most outcrops of cherty sediments with mass-flow deposits in the Northern Calcareous Alps were in recent times mostly named Tauglboden Formation.
Definition: gray and black cherty sediments with mass-flow deposits and allochthonous slides. Mostly bedded or laminated cherty limestones, radiolarites and cherty marls, often rich in radiolarians, partly with filaments and spicula. The Sillenkopf Formation contains mass-flow deposits in the Kimmeridgian (dated by radiolarians and resedimented shallow-water components) with: 1. Dolomites and limestones of the Pötschen Formation, Late Triassic. 2. Cherty sediments of the Ruhpolding Formation 3. Late Kimmeridgian shallow-water carbonates. 4. Protoglobigerina-wackestones, Klaus Formation. 5. Carbonate-cemented sandstones. 6. Crystalline components. 7. Haselgebirge (salt-clay mudstone, gypsum), Permian. 8. Magmatic quarz.
The stratigraphic range of the cherty sediments of the Sillenkopf Formation (cherty limestones and radiolarites – Kimmeridgian to Tithonian)) is therefore partly equivalent to the Tauglboden Formation (cherty sediments – Oxfordian to Early Tithonian). The pebbles of these mass-flow deposits are completely different to those of the Tauglboden Formation, where the components derived from the Trattberg Rise = local material from the late Triassic lagoonal facies belt of the Northern Calcareous Alps. The age of the cherty sediments of the Sillenkopf Formation (cherty limestones and radiolarites is therefore equivalent to the Tauglboden Formation.
Thickness of the sedimentary sequence: nearby 100 m in the type region with the mass-flow deposits. With slides, mostly alpine Haselgebirge nearby 1000 m. Base of the Sillenkopf Formation: cherty marls, cherty limestones and radiolarites of the Strubberg Formation followed by red cherty limestones and radiolarites of late Oxfordian age – Gotzental Member. Top of the Sillenkopf Formation: unknown.
Type section: Sillenkopf section. The section is not complete in the mass-flows and slides. Type section starts in late early Kimmeridgian overlying alpine Haselgebirge. For the base of

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the sedimentary sequence see section Abwärtsgraben (MISSONI et al. 2001) and Gotzental (MISSONI 2003).

Type area: northern part of Hagengebirge and Steinernes Meer south of Berchtesgaden.

Regional distribution: The Sillenkopf Formation stretches from the Königssee area in the west to the area of Bad Mitterndorf in the east. The Sillenkopf Formation is exposed in the southern Berchtesgaden Alps, the Hallstatt area and Bad Mitterndorf. Sediments of this Formation were formerly attributed to the Tauglboden Formation .

Age of the Sillenkopf Formation: Early Kimmeridgian to Tithonian (dated by radiolarians, foraminifers and algae).

Underlying sediments: red laminated cherty limestones to radiolarites of the Ruhpolding Formation, Gotzental member and Strubberg Formation over red nodular limestones of the Klaus Formation or liassic sediments after a sedimentary gap.

Overlying sediments: unknown.

Differences to other formations: The differences to the Strubberg Formation, Tauglboden Formation with polymictic mass-flow deposits and Barmstein Limestones are:

a) stratigraphic range
b) components and slides
c) paleogeographic position due to basin formation.

Strubberg Formation: older (Callovian to Oxfordian), with underlying red radiolarite of early Callovian age. Components only derived from the Hallstatt facies zone and adjacent shallow water areas of the Triassic carbonate platform (= Hallstatt Mélange).

Tauglboden Formation: Oxfordian to early Tithonian, with underlying black or red radiolarite of Callovian to Oxfordian. Components derived only from a nearby topographic high (Trattberg Rise).

Barmstein Limestones: From the allodapic Barmstein Limestones, which occur on top of the Tauglboden Formation, the resediments of the Sillenkopf Formation differ mainly by their clast spectrum, matrix, biostratigraphy and geodynamic setting (see MISSONI et al. 2001). Resedimentation of clasts in the Sillenkopf Formation ended in the Late Kimmeridgian or early Tithonian. Clasts of inner platform settings (wackestones), a common constituent of the Barmstein Limestones, are missing in the Sillenkopf Formation. The Barmstein Limestones are dated as Upper Tithonian to Berriasian and occur only in the area of the Tauglboden Basin overlying the Tauglboden Formation.

Remarks: The shallow water components in the mass-flow deposits and allodapic layers in the Sillenkopf Formation are of great interest, because formerly the Late Jurassic platform carbonates were generally interpreted as neoautochthonous cover after the late Middle to early Late Jurassic tectonic event due to the closure of the Tethys Ocean. The Late Jurassic carbonate platform (Plassen carbonate platform) in Kimmeridgian to early Tithonian times was formed south of the Trattberg Risein the area of Lammer and Sillenkopf basins. In late Kimmeridgian and Tithonian the platform progrades to the south sealing the slides of the whole Lammer and northern part of the Sillenkopf Basin. These platform shed in late Kimmeridgian to early Tithonian material only to the south. But in the Sillenkopf Formation also occur shallow water material since Early Kimmeridgian from a southern platform. So the analysis of this shallow water debris is therefore of great importance for the paleogeographic reconstruction of this carbonate platform and its evolution. Contemporaneous in the Tauglboden Basin north of the Trattberg Rise cherty sediments with mass flows were deposited. From the late Early Tithonian the platform sealed the Trattberg Rise and shed material also to the north into the Tauglboden Basin.

In the geodynamic context, the sedimentation of the Sillenkopf Formation took place during a shallowing upward cycle evidenced for example recently at the type-locality of the Plassen Formation in connection with platform progradation. On the other side, the sedimentation of the Barmstein Limestones happened during a time where a transgression (deepening

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sequence) is reported from the Plassen carbonate platform. Barmstein limestones only occur in the area of the Tauglboden Basin.

The former interpretation, that the Late Jurassic carbonate platform forms the neoautochthonous cover (Late Oxfordian to Late Berriasian) after the Late Middle to early Upper Jurassic tectonic event representing a phase of tectonic quiescence, cannot be confirmed.

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Artikel/Article: Definition of the Sillenkopf Formation in the Sillenkopf Basin (Late Jurassic, Northern Calcareous Alps) 275-277