

DEFINITION OF THE STRUBBERG FORMATION (CALLOVIAN TO OXFORDIAN) IN THE LAMMER BASIN (NORTHERN CALCAREOUS ALPS)

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The type area of the Strubberg Formation (Lammer unit = Lammer Basin) is located between the Osterhorn Block (Trattberg Rise) in the north and the Tennengebirge in the south and was formed as an elongate trough in the former area of the Late Triassic lagoonal carbonate platform (Tirolicum of the Northern Calcareous Alps, former Staufen-Höllengebirgs nappe; Upper Tirolitic unit – FRISCH & GAWLICK 2003).

The Lammer Basin contains a more than 1.5 km thick series of Callovian/Oxfordian deep-water cherts and shales intercalated with breccias, mega-olistoliths and slides (Strubberg Formation). This trough was formed in the former area of the Late Triassic lagoonal carbonate platform. The redeposited rocks were derived from the continental margin along the southern rim of the Northern Calcareous Alps (Dachstein reef tract and Hallstatt Zone).

The basin fill is composed of Callovian/Oxfordian deep-water sediments (radiolarites, cherty limestones, marls), which contain in the type area different types of mass-flow deposits and large slide masses in the early and middle Oxfordian. Examination of the stratigraphy and facies of the resedimented clasts and blocks suggests that the Hallstatt Zone and adjacent facies belts (Dachstein reef tract, Pötschen Formation, Hallstatt limestones, Meliaticum) were destroyed and that their Triassic to Liassic sediments were eroded or mobilized as slides and redeposited in the Lammer Basin. Sediment redeposition in the Lammer Basin ended in the middle Oxfordian, later as the formation of the Trattberg Rise and the Tauglboden Basin to the north. After a sedimentation gap in the early Kimmeridgian on top of slides, shallow water carbonates of the Plassen Formation were deposited on top of several slide masses.

Name of the Strubberg Formation: CORNELIUS & PLÖCHINGER 1952.

Derivation of name: Mount Strubberg south of Abtenau as type section.

Remarks: The problem of the area around Strubberg is, that the cherty sediments in this region are tectonically separated from the base and the top, also in this area the diagenetic overprint is high. Mass-flow deposits are missing around Mount Strubberg. So the section Sattlberg west is defined as new type section.

History: In the type area the cherty sediments with mass-flow deposits are called Strubberg Formation. They are dated by underlying sediments; CORNELIUS & PLÖCHINGER (1952) give an age range between late Liassic and Oxfordian. Other outcrops of cherty sediments with mass-flow deposits in the Northern Calcareous Alps were in publications times mostly named Tauglboden Formation. Also a lot of outcrops of the Strubberg Formation were mapped as Allgäu Formation (e.g. geological maps of Bad Ischl), partly with mass-flow deposits, which are named as „Grünanger Brekzie“ with an age range of Pliensbachian to Oxfordian.

Definition: mostly cherty sediments (gray and black) with mass-flow deposits and allochthonous slides (Hallstatt Mélange): Hallstatt limestones, Pötschen limestones and dolomites, components and slides of the Triassic reef rim. Mostly bedded or laminated cherty limestones, radiolarites and cherty marls, rich in radiolarians; manganese-rich sediments.

Thickness of the sedimentary sequence of in the Lammer Basin (Strubberg Formation): 1800-2000 m in the type region with the mass-flow deposits and the slides; without slides, only with the mass-flow deposits about 250 m. This can be visited on the type section west of Sattlberg and in the Infangalm and Lammeregg area. The Lammer Basin fill in the central Northern Calcareous Alps (= Hallstatt Mélange) contains in the whole central Northern

Calcareous Alps a more than 1000 m sedimentary sequence including slides. Base of the Strubberg Formation: red radiolarite of early Callovian age – Klauskogelbach Member. Top of the Strubberg Formation: in the south red cherty limestones and radiolarites of late Oxfordian age – Gotzental Member; in the north partly a stratigraphic gap and early Kimmeridgian pelagic limestones on base of the Plassen Formation.

Type section: a new type section was defined by GAWLICK (1996, 2000) and GAWLICK & SUZUKI (1999) for the Strubberg Formation: the Sattlberg section south Oberscheffau on the forest road west of Sattlberg.

Type area: Lammer valley east of Golling on the northern rim of Tennengebirge.

Regional distribution: The Lammer Basin stretches from the Lofer area in the west (former Berchtesgaden-Kühroint Basin, former parts of Schwendt-Glasenbach Basin) to the area of Bad Mitterndorf in the east (sediments were formerly mostly dated as Liassic Allgäu Formation).

Age of the Strubberg Formation: Early Callovian to middle Oxfordian (dated by radiolarians – e.g. GAWLICK & SUZUKI 1999).

Underlying sediments: partly red radiolarite (early Callovian) of the Klauskogelbach member) over red nodular limestones of the Klaus Formation or Liassic sediments of the high Adnet Group after a sedimentary gap.

Overlying sediments: in the south red cherty limestones and radiolarites (late Oxfordian) of the Gotzental Member); in the north partly a stratigraphic gap (late Oxfordian) and early Kimmeridgian pelagic limestones on base of the Plassen Formation followed by shallow water carbonates.

Differences to other formations: The differences to the other formations (Tauglboden Formation, Sillenkopf Formation) with polymictic mass-flow deposits are:

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

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

Sillenkopf Formation: Kimmeridgian to ?Tithonian, with underlying Strubberg Formation and underlying reddish cherty sediments (Gotzental member), components of mixed origin (Hallstatt Mélange, local materials, late Jurassic shallow water clasts).

Description of the basin fill: The sedimentary record in the Lammer Basin starts in the Early Callovian with cherty limestones, radiolarites and marlstones. Upsection thin turbidites and, later (Oxfordian), different types of internally chaotic debris-flow deposits with variable matrix content are intercalated. The overlying, typically radiolarian-rich parts contain mass-flow deposits bearing various clasts derived from the proximal Hallstatt Zone (Pötschen Formation of Zlambach facies; Carnian to Norian). Further upsection, mass flow deposits with small resedimented clasts of Late Triassic condensed cephalopod limestones (Hallstatt limestone) rarely occur together with large slides of Pötschen Formation of the same age. A younger generation of mass-flow deposits also contains Pötschen Formation material but ranging in age from Anisian to Liassic. The middle part of the Strubberg Formation (~Middle Oxfordian) is characterized by large resedimented blocks and sheets of the siliciclastic Werfen Formation (Scythian). These are overlain by 2-3 km sized slides of the Pötschen Formation composed again of various dolomites and limestones (Carnian to Liassic). Mass-flow deposits on top of these large slides contain clasts and hectometric blocks of the Hallstatt cephalopod limestones (Carnian to Norian) and small clasts of Middle Triassic radiolarites and cherty limestones. This facies suggests an origin from the distal parts of the Hallstatt Zone (Hallstatt Salzberg facies and Meliaticum). The piggy-back transportation (relicts of an older basin formed in the south) of distal Hallstatt Salzberg facies and Meliaticum

components in slide masses derived from the Zlambach facies area show that Callovian to Oxfordian resedimentation was a multiple process. These slides are overlain by mass-flow deposits (~Middle Oxfordian) with clasts from the Pötschen Formation (Carnian to Norian). The upper part of the Strubberg Formation (Middle to ?Late Oxfordian) is characterized by mass flows and slides bearing clasts of Hallstatt limestones (Carnian to Norian). In these mass-flow deposits components from the Dachstein reefal limestone facies occur. The sequence is terminated by large slides of the reefal Dachstein limestone facies zone (Scythian to Liassic). These are, in turn, overlain by mass-flow deposits and by large blocks and slides derived from the typical Hallstatt Salzberg facies. Sediment redeposition ended in the typical Lammer Basin (= Strubberg Formation) in the ?late Oxfordian, contemporaneous with the formation of the Sillenkopf Basin to the south and sediment redeposition from the Trattberg Rise in the Tauglboden Basin to the north. In Kimmeridgian to Early Berriasian times, limestones of the Late Jurassic carbonate platform (i.e., Plassen Formation) were deposited on top of several slide masses sealing the chaotic basin fill. Sediments from of the shallow water carbonate platform shed to the south filling up the Lammer Basin and the northern parts of the Sillenkopf Basin.

The sedimentation trend in the Lammer Basin fill reflects the progressive closure of the Tethys Ocean by the stepwise distal to proximal mobilization of the Hallstatt Zone.

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