FIELD STOPS IN THE EASTERN ALPS SOUTH OF SALZBURG

PASS LUEG

The information for this field stop is taken from a guidebook prepared by Ariel A. Roth in 1998.

LOCATION

Take the autobahn south from Salzburg for about 30 km to Golling exit. Go east toward Golling, and as you reach the town, turn south on the old highway going to Bischofschofen, etc. About 3 km south of Golling

FIGURE 1. View of three Lofer cyclothems just north of the tunnel at Pass Lueg.

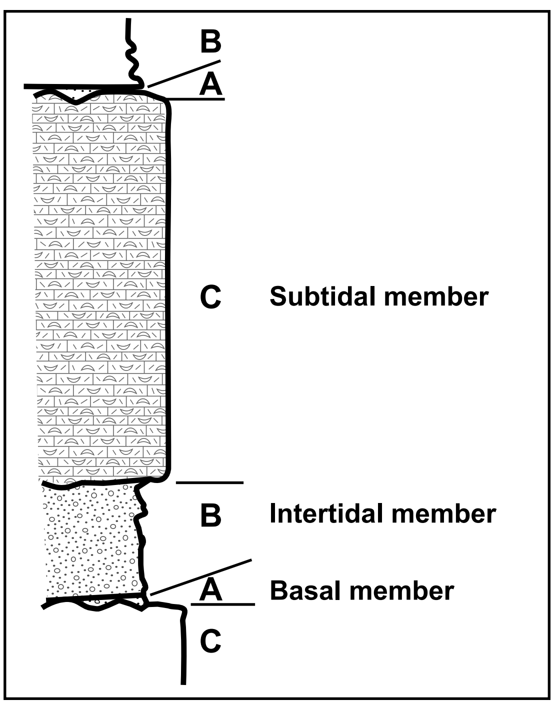

FIGURE 2. Dachstein limestone. Lofer cyclothem. Structures interpreted as follows: A— basal member of conglomerate with red or green matrix sometimes only in cavities. B— intertidal member consisting of fine laminated sediments, few fossils, algal mats, and dessication features. C — subtidal member consisting of a more fossiliferous limestone including the large bivalve *Conchodus infraliasicus*, algae, other molluscs, and solution features. A complete cyclothem may vary in size up to several m.

is the Pass Lueg area. Across from the road to the large industrial plant north of the tunnel is a good exposure of the Dachstein limestone. Also north of the tunnel on the southwest side of the road are some fossils and glacial grooves on a sloped limestone surface near road level. The best fossils will be found by taking a trek down the "Klamm." The path starts above the tunnel. Look along the sides of the rocks near the lower parts of the gorge.

DESCRIPTION

The exposures of Lofer cyclothems (Fig. 1) are of the upper Austro-Alpine paleogeographic realm. More specifically these are interpreted as Triassic marine limestones of the Dachstein Formation. The layers which alternate between massive limestone and limy shale represent the Lofer facies. These sequences are said to represent cyclothems with the typical sequence illustrated in Figure 2.

As you examine the outcrops, you should note the following: massive limestone layers, shaley lime layers, relation of thickness of units, dipping of the bed, cracks, load casts on the underside of massive limestone layers (Fig. 3), fossils of a variety of molluscs, orientation and closure of the molluscs' shells. The fossils can be best studied in the areas exposing glacial polish (Fig. 4) and in the "Klamm" (Fig. 5).

A brief summary of the present interpretation by geologists is given in the following quotation from Matura and Summesberger (1980, p 149):

FIGURE 3. View looking up at the underside of a C unit in a Lofer cyclothem. The numerous bulbous forms which project downwards are called load casts. Load casts are often associated with turbidites. One bulb would be around 10-20 cm in diameter.

> *After Fischer the Dachstein formation comprises about 300 cycles, each representing a timespan of 20,000 to 100,000 years. For the whole formation of 1,000 to 1,500 m thickness a timespan of 15 million years is calculated. To explain the mechanism of the Lofer cycles Fischer assumed a periodical fluctuation of the sea level superimposing the general subsidence. After Zankl (1971) it is necessary to assume a third criterion to give a full explanation: current activity should be an additional factor for mass distribution and regular bedding, additional to general subsidence and low amplitude eustatic sea level changing.*

FIGURE 4. Exposed layers of the Dachstein Formation just north of the tunnel at Pass Lueg. In the lower left part of the figure, note the parallel grooves from glacial activity. Several good fossils can be found in this exposure.

FIGURE 5. Fossils of the bivalve *Conchodus infraliasicus* in the Dachstein Formation as seen in the "Klamm." The larger shells are about 10 cm long. Note that many of the shells are closed, indicating rapid burial while alive.

Satterley (1996) proposes a more local autocyclic process based on Ginsburg's (1971) model of accumulation (progradation) of sediments cyclically covering up their sources.

A Creation-Flood Perspective

It would seem that the mass distribution suggestion above is warranted. This could reflect catastrophic activity. Good preservation of large fossils (10 or more cm) would require fairly rapid burial. The fact that many of the bivalve fossils are closed (Fig. 5) suggests rapid burial before the animals had died. The load casts (Fig. 3) and some of the bedding sequences (Fig. 1) suggest a rapid turbidite type of deposition. The formation of Lofer cyclothems at a rate of 20,000 to 100,000 years each for a period of 15 million years would seem to require an unusual set of fortuitous circumstances. It would require that subsidence for 1000 to 1500 m proceed at such a uniform rate that the area of deposition be kept at the tidal-subtidal level for 15 million years. It would seem that other models should be considered.

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VIEW OF THE TAUERN WINDOW

LOCATION

One can get a general view of a small portion of the Tauern Window by approaching it from the north east on the road between Pass Lueg and Zell am See. Proceed southeast from Bischofshofen for about 16 km just to the east of the town of Schwarzach. If you want to examine closely the main kinds of rocks in the window, you can go west to Lend, south to Bad Hofgastein (schist layers), then to Badgastein (gneiss).

DESCRIPTION

The Tauern Window gives a good introduction to some of the dramatic changes that have taken place in the eastern Alps, and is a magnificent example of Alpine tectonics. As N-S compression has taken place, various units have slid over others. Occasionally orogeny and/or erosion has exposed some of the lower covered-up units in what are called “windows.” These exposures have provided strong support for lateral compression con cepts of the Alps. The Tauern Window is the largest example of a tectonic window in the eastern Alps.

During the formation of the eastern Alps the lower Austro-Alpine domains ended over the Penninic (Pennine) zone, the upper Austro-Alpine zone ended even further to the north. The cross-sections in Figure 1 illustrate in a general way the changes envisioned. The window is illustrated by the Penninic exposed in the middle of Figure 1B. Figure 2 shows the view from Schwarzach.

As you look to the southwest from Schwarzach, the highest hill (in the far distance) to the right of the apparently higher hills in the foreground, is part of the Penninic paleogeographic domain, while the hills in the foreground are the Austro-Alpine “frame” of the window (Fig. 2). The layers forming the Austro-Alpine frame once covered the Penninic, but have been eroded, exposing the Pennine layers seen in the distance at the right ¼ in Figure 2. In other words, the oldest and normally lower Penninic layers pop up through the horizontal-lying Austro-Alpine frame of the window.

The geology of the Penninic Tauern Window is complex. In general there is an outer schist-like portion over a gneissic core. You can see these main kinds of rocks in road cuts near Bad Hofgastein (schist) and Badgastein (gneiss).

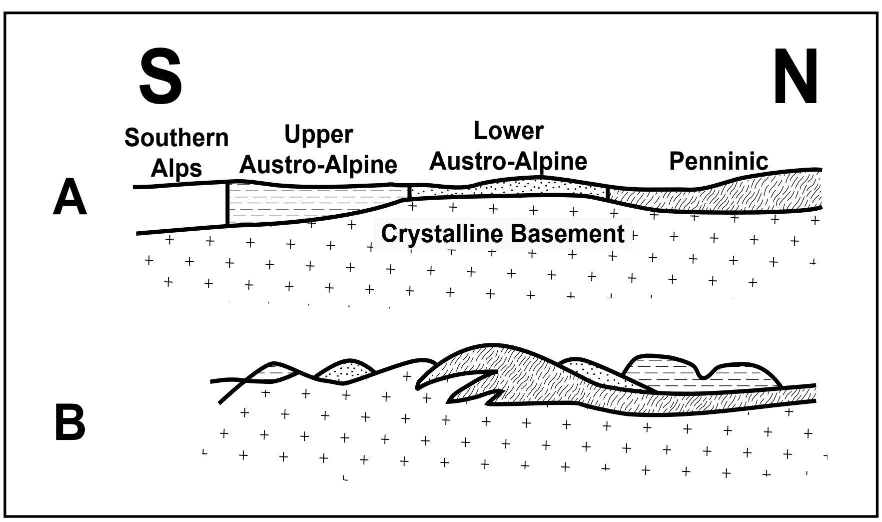

FIGURE 1. Generalized tectonic model for the formation of the eastern Alps. A, Mesozoic arrangement; B, present arrangement after the layers have been pushed to the north of A.

FIGURE 2. View to the east from the town of Schwarzach into the Tauern Window. The lower Penninic paleogeographic domain is now exposed in the peaks to the right of the picture. The hills in the left ¾ of the picture are of the Austro-Alpine paleogeographic domain. These Austro-Alpine units, which were pushed over from the south (left), once covered the Penninic units now seen in the peaks at the right. Their subsequent erosion exposed the lower Penninic units, resulting in what is called a tectonic window.

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VORDERER GOSAU LAKE AREA

LOCATION

Go to the town of Gosau, then south to the northwest end of Vorderer Gosau Lake.

DESCRIPTION

Gosau Lake is a glacial lake; the valley in which it lies has been carved out largely by glacial action. The northwest edge of the lake is a terminal glacial moraine. The surrounding hills are interpreted as a reef complex in the Triassic of the northern Austro-Alpine paleogeographic domain. Figure 1 gives the basic pattern of a reef.

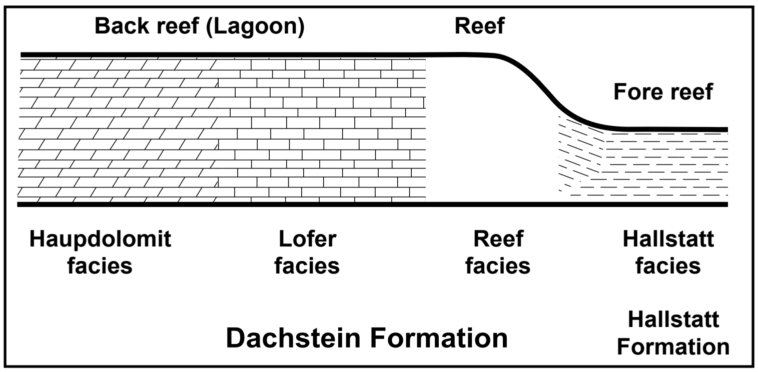

FIGURE 1. General structure of a reef and proposed original facies arrangement of a reef in the upper (northern) Austro-Alpine of the eastern Alps.

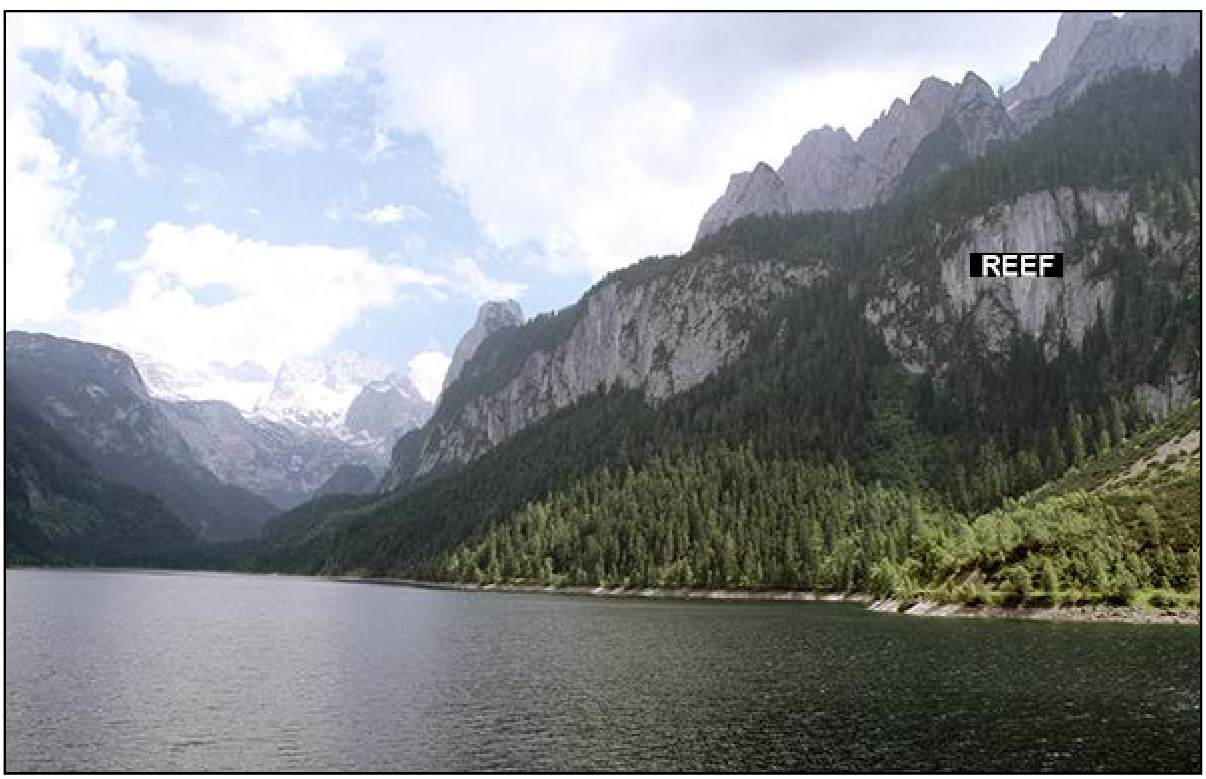

FIGURE 2. View of the massive reef (right) on the east side of Gosau Lake.

In this location you can get a view of what is considered one of the largest reef complexes of the Calcareous Alps of Austria. As you stand at the northwest end of the lake, on a clear day you can look south (toward the lake) at the high peaks of the Dachstein group. These layered carbonates represent the Lofer cyclothems of the backreef (lagoon). To the southwest (right) is the reef facies (Fig. 2) which nearly comes down to lake level. To the west (right and behind you as you face the lake) is the Hallstatt forereef facies.

On the southwest (right) side of the lake is a talus slope which has some typical fossils from the reef facies. Fossils include mainly sponges (Fig. 3), coral, algae, and molluscs.

The tectonic relation of the Hallstatt facies to the Dachstein facies has been the subject of extended controversies. Some suggest major overthrusting, while others suggest minor changes from the present relationship. These models could greatly affect the degree of lateral (N-S) compression involved in the transport of the Northern Calcareous Alps which are estimated to be 1.5 - 5 times smaller, in a N-S direction, compared to the original paleogeographic domain Regardless, it is agreed that the reef has been transported from a long distance from the south during the formation of the Alps.

FIGURE 3. A fossil sponge from the reef region at the north end of Gosau Lake. The sponge is the darker round object (near the middle of the picture) having a small light center and a darker filled-in crack cutting across it.

A CREATION-FLOOD PERSPECTIVE

Growing a reef this size would take many thousands of years, and this would preclude placing such a structure within the year of the Genesis flood. This Triassic reef lies in the middle of the geologic column with many layers of fossils below and many above. If this is a true reef which grew in its present location, it is a challenge to the biblical account of a recent, all-inclusive creation and the destruction of life during a one-year flood.

One could suggest that this reef grew between creation and the flood and was moved to its present location during the flood. Probably all geologists agree that the Dachstein Limestone, which contains this reef, was transported at least many dozens of kilometers from an ocean to the south.

A more likely creationistic explanation is that this is not a true reef. A true reef is formed by organisms producing a wave-resistant structure. As can be seen by examining the fossil-bearing rocks, there is an abundance of detritus (sediment) between the fossils. Detritus is not wave-resistant when laid down. If this was a true reef, it should be a solid mass of fossils including more reef-frame building and binding organisms such as coral and algae.

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HALLSTATT SALT DEPOSIT

LOCATION

A good view of the region can be found at the south end of Hallstätter See. Several beach facilities provide convenient observation points.

DESCRIPTION

The Hallstätter lake is in a steep-walled, fjord-like valley. Looking to the northwest, one sees the town of Hallstatt. The salt deposits are above this town (see Figs. 1 and 2).

FIGURE 1. View to the west of Plassen Mountain showing the location of the salt deposits behind the town of Hallstatt. See Figures 2 and 5 for explanation.

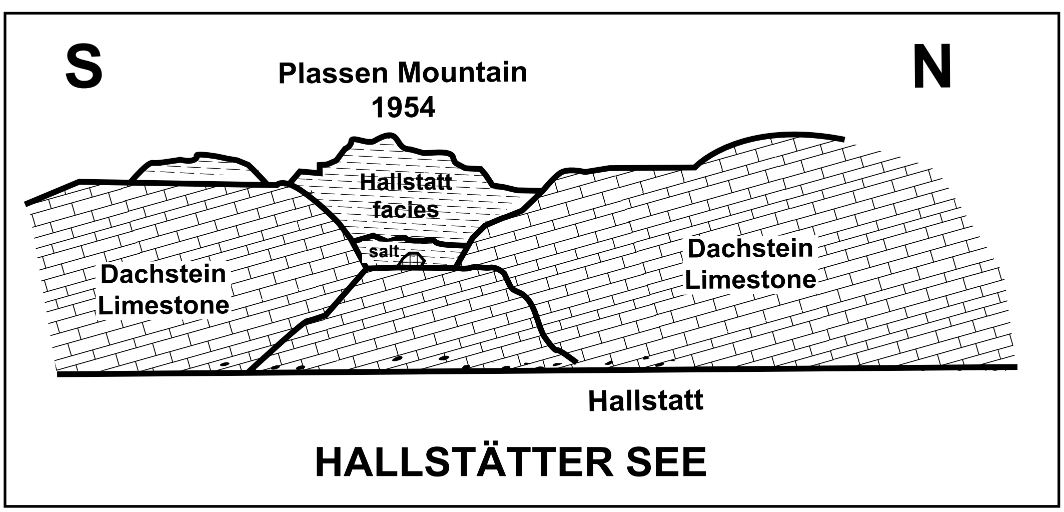

FIGURE 2. Diagram interpreting the region around Plassen Mountain.

The salt comes from the Upper Permian "Haselgebirge" beds at the base(?) of the Triassic Hallstatt deposits. This layer is a combination of salt, gypsum, anhydrite, clay, dolomite, some volcanic rocks, etc. It is an important sliding horizon in the Northern Calcareous Alps and is considered to be part of the famous Zechstein salt deposits which are widespread in northwestern Europe. Usually the salt is layered and mixed with clay (Figs. 3 and 4).

FIGURE 3. Close-up view of light-colored salt and darker surrounding clay and other minerals. The photo from the Bad Ischl salt mine is about ½ m across.

FIGURE 4. Close-up view of lighter salt and darker clay layers from the purer salt deposits. Note the offset of layers due to movement of the deposit. Photo from the Bad Ischl salt mine is about ½ m across.

The origin of the salt is assumed to be by evaporation of seawater. Under normal conditions this process would take considerable time. Origin by transport from another "original" salt locality would not take so long. Obviously some transport is implied in the local deposits as the salt includes huge blocks of entrained limestone and schists (Fig. 5). How it has come to its present location, i.e., from above or below, is a disputed point. All agree that there has been some transport.

This is a convenient place to point out the distinction between geography, paleogeography, tectonics, and stratigraphy. Geographically you are near Hallstatt; paleogeographically this is the original upper Austro-Alpine domain that was originally much further south; tectonically according to the classic model the Dachstein facies is the Upper Juvavicum tectonic unit or sheet, while the Hallstatt facies is the Lower Juvavicum; stratigraphically the Dachstein Limestone is Triassic, while Plassen Mountain represents a sequence from Permian (salt) to Upper Jurassic (Malm) at the top. The upper part of Plassen Mountain has been interpreted as a reef limestone.

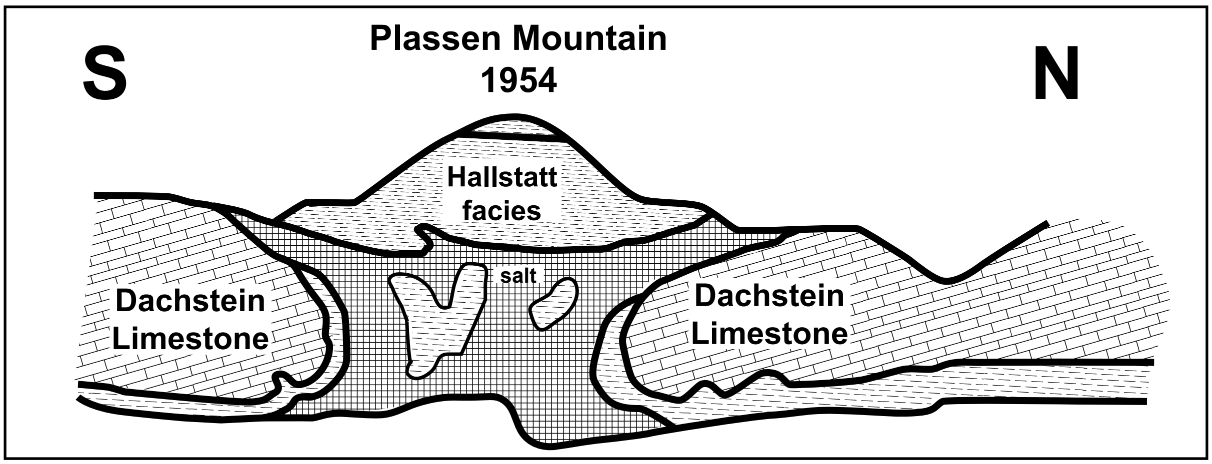

FIGURE 5. Section in the region of Plassen Mountain showing the Hallstatt Salt Deposit. The top of the peak has been interpreted as a Jurassic reef. Note the large inclusions in the salt mass.

Salt has been mined here for 3000 years. The local deposit is about 50-60% salt. Salt has been leached out from the sediments at the mountain surface. The mine shafts go down about 700 m to 12 horizons. There are 32 km of tunnels and shafts in the mine. Solution mining, where water is used to dissolve the salt, is employed at present. The saturated brine is piped 40 km to Ebensee where it is evaporated to extract the salt.

A CREATION-FLOOD PERSPECTIVE

The serious question between creation and non-creation interpretations is the amount of time involved in the evaporation of seawater to produce all the salt. Alternatives would include methods of depositing the salt rapidly such as transport from an original primordial salt source during the Genesis flood, or formation of salt from hot brines as has been reported from the deep ocean. These possibilities need further investigation.

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STEINPLATTE REEF

LOCATION

On a clear day the reef can be viewed at a distance from all the region around the town of Waindring. A convenient place is to look to the northeast along Highway 312, 3 km west of the west connector road to Waindring.

DESCRIPTION

The Steinplatte Reef is a famous classic example of a Triassic reef of the Upper Austro-Alpine paleogeographic realm. It forms a dramatic limestone cap in the High Calcareous Alps of western Austria. As viewed from the west, the main cliff of exposed limestone at the top of the hill (Fig. 1) represents the forereef (Fig.2), the reef core lying behind and on top of this cliff. The reef has been studied for over a century. Fossils are not scarce, but do not present a convincing picture of a defined reef structure. There have been at least 3 major studies giving different identifications for the various parts of the reef (Piller 1981).

FIGURE 1. The Steinplatte Reef as viewed from the west. The pale limestone cliff at the top (partially covered with clouds) represents what is considered to be the forereef.

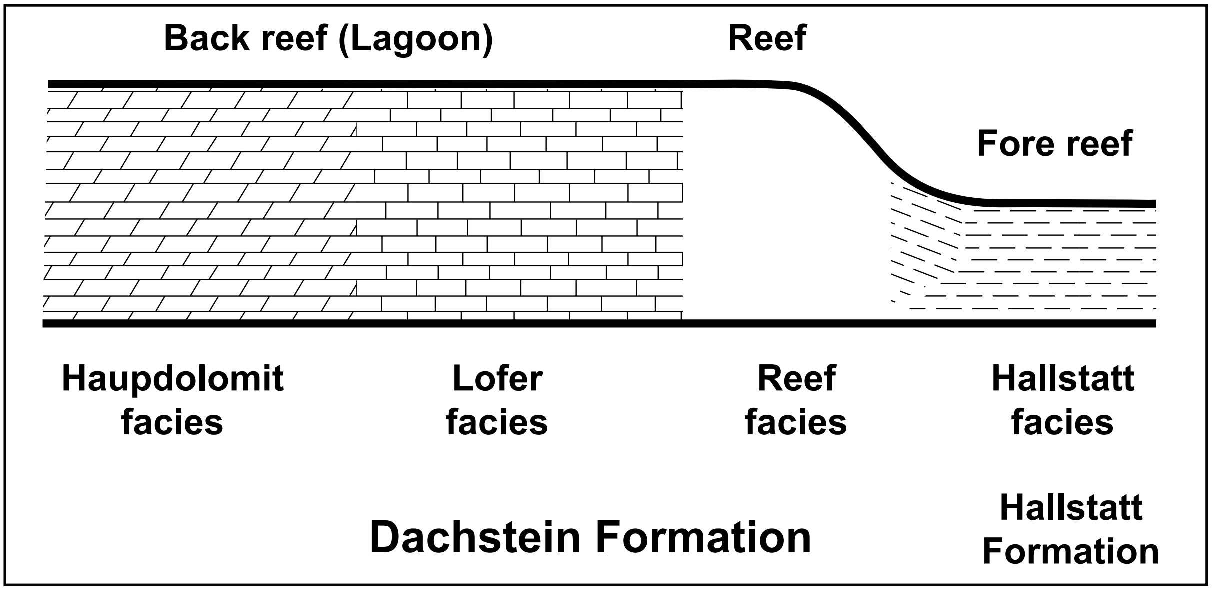

FIGURE 2. General structure of a reef and proposed original facies arrangement of a reef in the upper (northern) Austro-Alpine of the eastern Alps.

A CREATION-FLOOD PERSPECTIVE

As mentioned for the reef at Gosau Lake, the presence of a reef such as this in the middle of the geologic column presents a major challenge to the biblical creation-flood model. However, the lack of a well-defined reef structure can suggest that this is not a real reef, but represents sedimentary deposition during the flood. A non-creationist geologist (Stanton 1988) recently studied the reef and pointed out the lack of a skeletal frame of organisms necesary to build a wave-resistent true reef. He characterized the so-called Steinplatte Reef as a "sandpile" and commented further that "The Steinplatte is not an ecological reef nor is it easily considered a reef by any other definition." Satterley (1994) agrees. A "sandpile" could be deposited rapidly during a flood. This reflects some of the problems of identifying ancient reefs.

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