3.1.5. Locality 4 – Gosausee: The Dachstein margin at Gosaukamm

This text is mainly taken from MARTINDALE et al. (2013) and MARTINDALE in RICHOZ et al. (2012).

In the Late Triassic scleractinian corals and hypercalcified sponges built large, diverse reef ecosystems, the most famous of which are the Dachstein reefs of the Northern Calcareous Alps. Some of the most well-known and well-studied reef material comes from the Gosaukamm; the reef material is early Norian through early Rhaetian debris shed from a nearby reef margin that is not preserved (WURM, 1982; KRYSTYN et al., 2009). Across the Gosausee from the Gosaukamm is the Gosausee margin of the Dachsteingebirge (Dachstein Mountain; Figs. 4, 5), which is largely intact, such that one can walk from the deep-water facies in the southwest, up through a shelf edge reef (the Gosausee reef), into well-bedded lagoon facies to the northeast (Fig. 17). Reefal units (Dachsteinriffkalk) are specifically well exposed along the forest road and are well constrained biostratigraphically; at the base of the

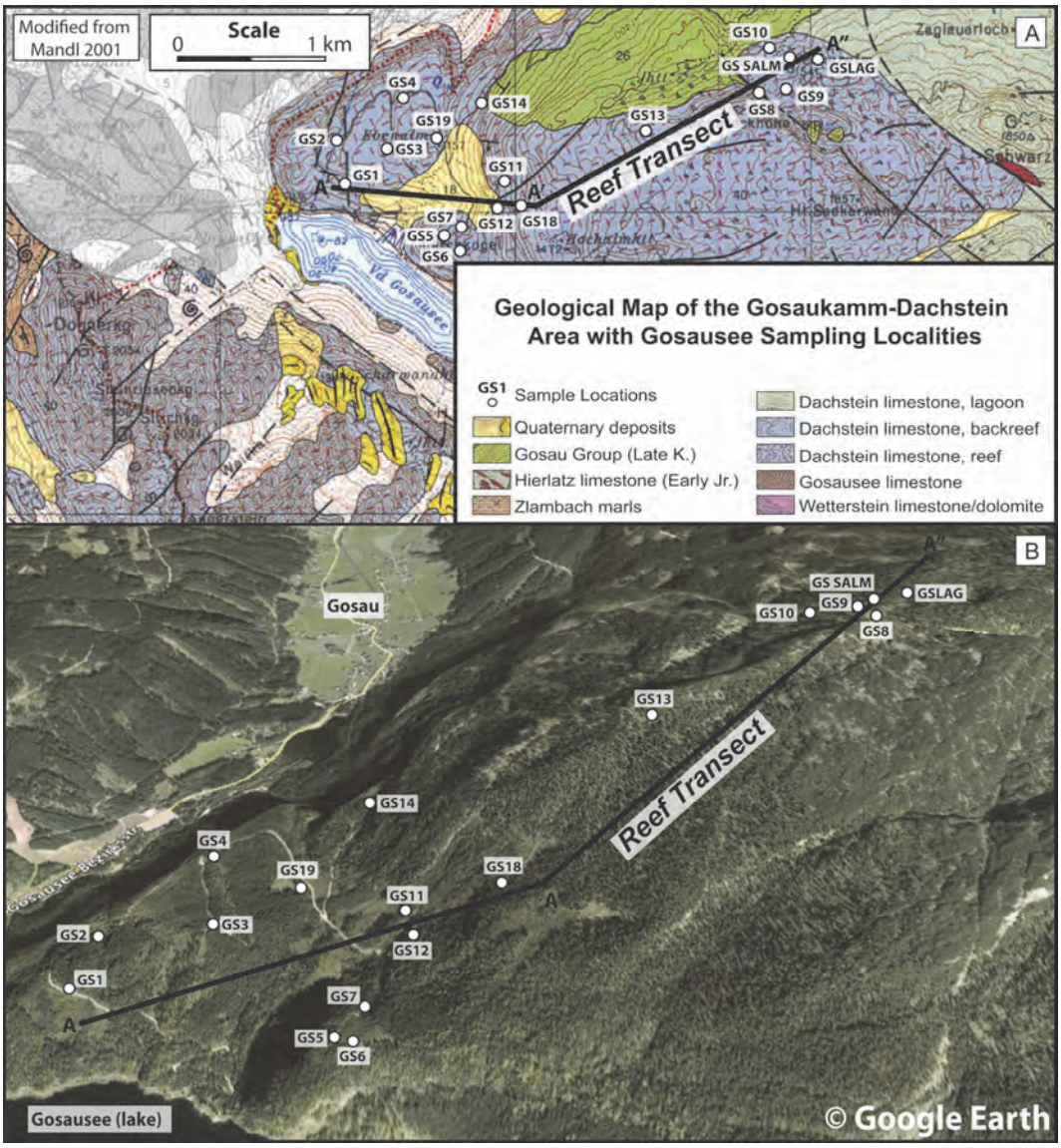

Fig. 17. The Gosausee margin of the Dachsteingebirge and sample localities from MARTINDALE et al., 2013 (transect A-A'-A" refers to reef cross section); A) Geological map of the Gosausee region, (modified from MANDL, 2001), with sample localities; B) Google Earth image of the Gosausee margin of the Dachsteingebirge, forest road visible. We will stop at GS1 and GS19.

Dachsteinriffkalk (approximately site GS1, Fig. 17), early Rhaetian conodonts, *Misikella hernsteini* and *Epigondolella bidentata* (=*Parvigondolella andrusovi sensu* KOZUR) have been identified, with additional early Rhaetian index fossils (*Norigondolelella steinbergensis, Misikella hernsteini, M. posthernsteini, Epigondolella mosheri, E. bidentata,* and *Oncodelella paucidentata*) from higher in the succession (Gosausee reef = *PI 4* unit of the Gosaukamm (KRYSTYN et al., 2009)). Reef growth continued through the early Rhaetian until the platform margin drowned in the middle Rhaetian (well before the Triassic-Jurassic boundary) and was covered by the pelagic Donnerkogel limestone (Donnerkogelkalk).

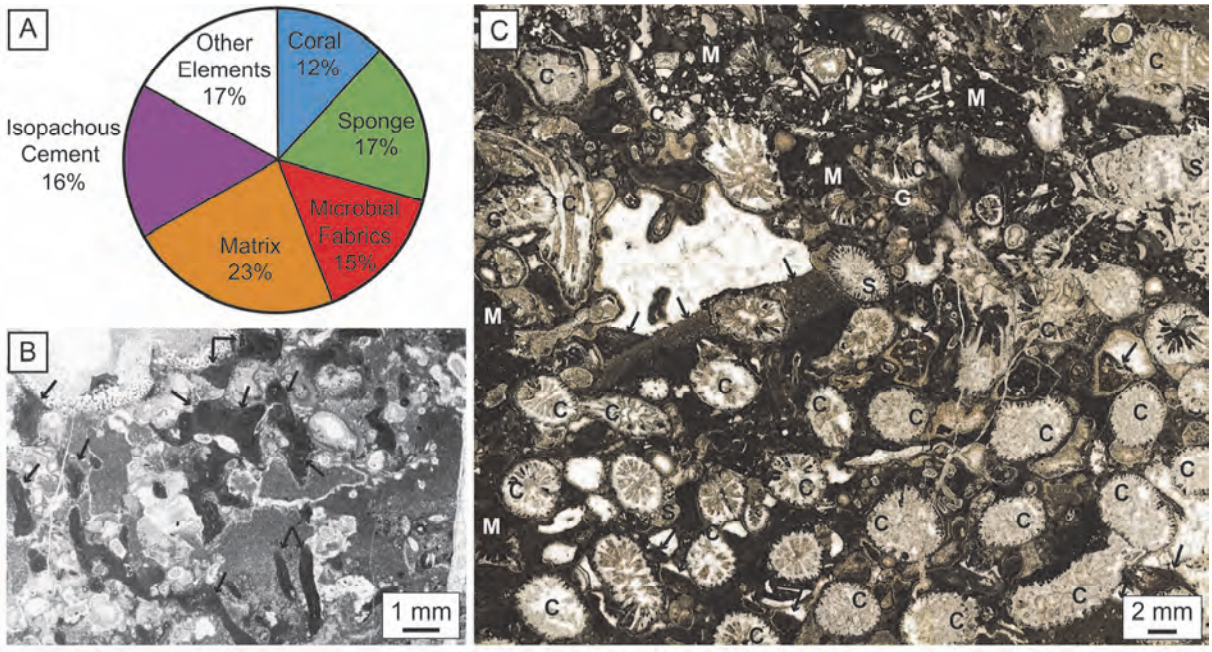

Fig. 18. The Gosausee fore reef facies from MARTINDALE et al. (2013). A) Fore reef facies composition based on mean values from point counting data (GS1, GS2, GS3, and GS4); B) "*Tubiphytes*" epibionts (best examples indicated by arrows), sample from site GS1, thin section photomicrograph (plane polarised light); C) Coral pillarstone and skeletal rudstone; note the abundance of the muddy skeletal wackestone matrix (marked with an M) and the multiple generations of geopetal sediment (arrows) and absence of thick microbialite fabrics (although there is a fine microbial crust in the largest cavity). Main phaceloid coral is *Retiophyllia gracilis* (some of the less well preserved corals are marked with a C), also present are spongiomorphids and chaetetid sponges (S), dasycladacean green algae (G) of the genus *Gryphoporella*, foraminifera (*Diplotremina* and *Endotriadella wirzi*), echinoderm fragments, and thin marine cements, sample from site GS1, thin section photomicrograph (plane polarised light).

The Gosausee reef is an intact microbial-sponge-coral barrier reef with an almost continuous fore reef to lagoon transect preserved, and thus provides a window into depth zonation of Dachstein-type reef facies and biotic succession. The Gosausee reef facies exhibit strong depth control and five classic reef facies or zones can be identified (MARTINDALE et al., 2013): the fore reef (Fig. 18), reef front, reef crest, back reef, and lagoon facies. Thin, rare microbial fabrics and a high abundance of fine-grained, mud-rich skeletal wackestones (transported reef debris) characterise the deepest fore reef (Fig. 19), particularly site GS1 (47°32.121' N / 13° 30.044' E, 1006 m above sea level) where we will stop (Fig. 17). As the reef shallows, muddy sediments decrease in abundance and are replaced by microbial fabrics, corals, and cements (Fig. 20). GS19 (47°32.206′ N / 13° 30.629′ E, 1157 m elevation, Fig. 17) is characterised by microbially bound coral pillarstones, brecciated and cemented skeletal rudstones, and coral sponge grainstones. Microbialite fabrics and corals (phaceloid,

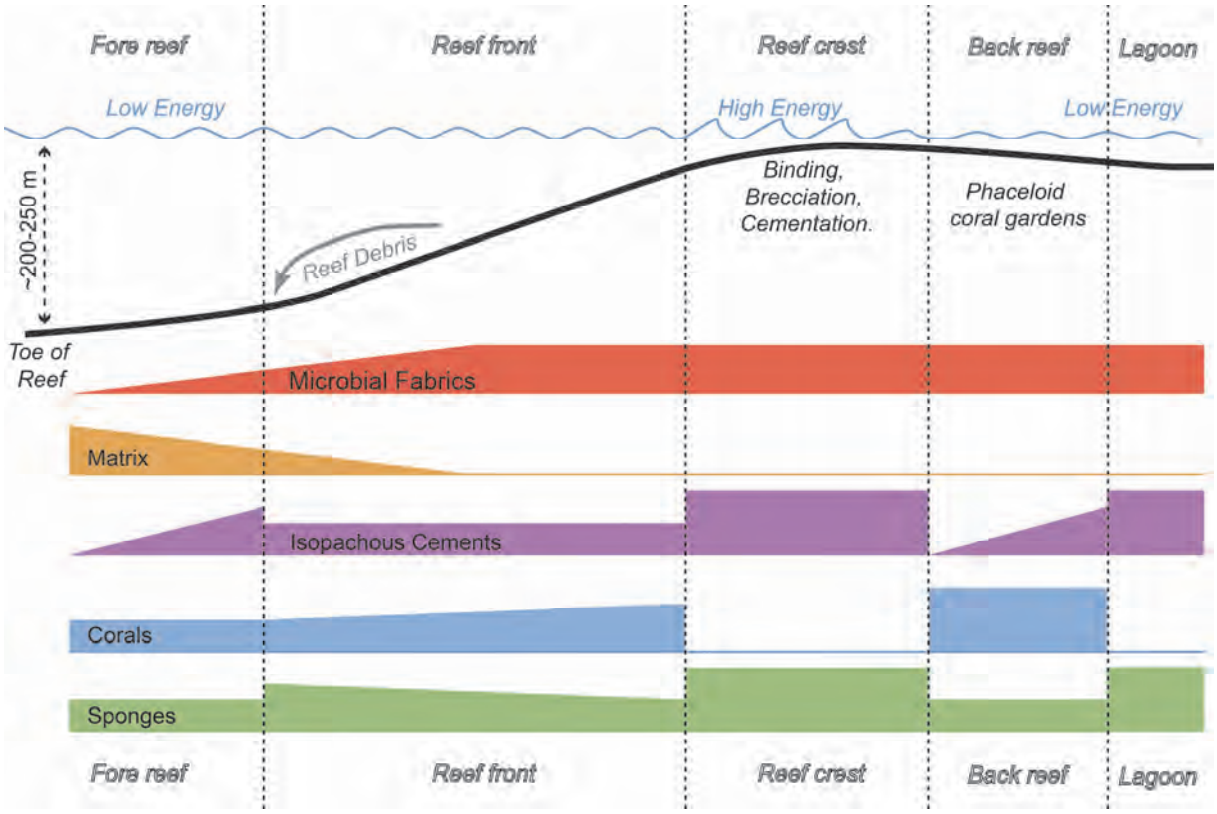

Fig. 19. Idealised transect of the Gosausee reef showing the trends in microfacies composition in different reef facies; fore reef = GS1–4; reef front = GS5–7, GS11–12, GS14, & GS18–19; reef crest = GS8 & GS13; back reef = GS9–10 & GS SALM; lagoon = GSLAG. From MARTINDALE et al. (2013).

thamnasterioid, and meandroid) are the two most volumetrically important components with contributions from sponges (encrusting and columnar) and rare gastropods, brachiopod and bivalve shells, echinoderm fragments, foraminifera, green algae, red algae, serpulid worm tubes, encrusting brachiopods, Microtubus, “Tubiphytes”, ostracods, bored sponges, intraclasts, and skeletal debris. The samples from this site seem compositionally and texturally more similar to samples from sites higher in the reef (e.g. GS12) than their nearest neighbors; it is probable that the carbonates from this site originated higher in the reef and were transported (either by synsedimentary transport of reef blocks, or by later tectonic movement). Abundant sponges, microbial crusts, and thick, marine cements typify the reef crest (near the Moderecкhöhe and the fault scarp below it, GS8 and GS13 in Fig. 17), whereas microbialite-coated phaceloid corals are dominant in the back reef facies (between the fault scarp and the Seekaralm, GS9 and GS10 in Fig. 17), which grades into heavily cemented oncoids or microbial-sponge bindstones of the lagoon (to the northeast of the Seekaralm (Figs. 17, 19). Based on their compositional, biotic, and diagenetic similarities, the Gosausee reef was likely part of the same barrier reef systems as the source reef for the Gosaukamm reef breccia (MARTINDALE et al., 2013). The highly resolved reef zones of the Gosausee margin can be used to interpret the depth or reef zone of less well preserved reef fragments and suggest the need to revisit previous assumptions about reef depth or zone based purely on abundance of corals, sponges, or microbialite fabrics (MARTINDALE et al., 2013). For example, the mere presence of sponge-dominated versus coral-dominated facies cannot be used to determine depth in these reefs, instead, the abundance of microbialites and cements versus muddy sediments is a much better indicator of relative depth within the reef.

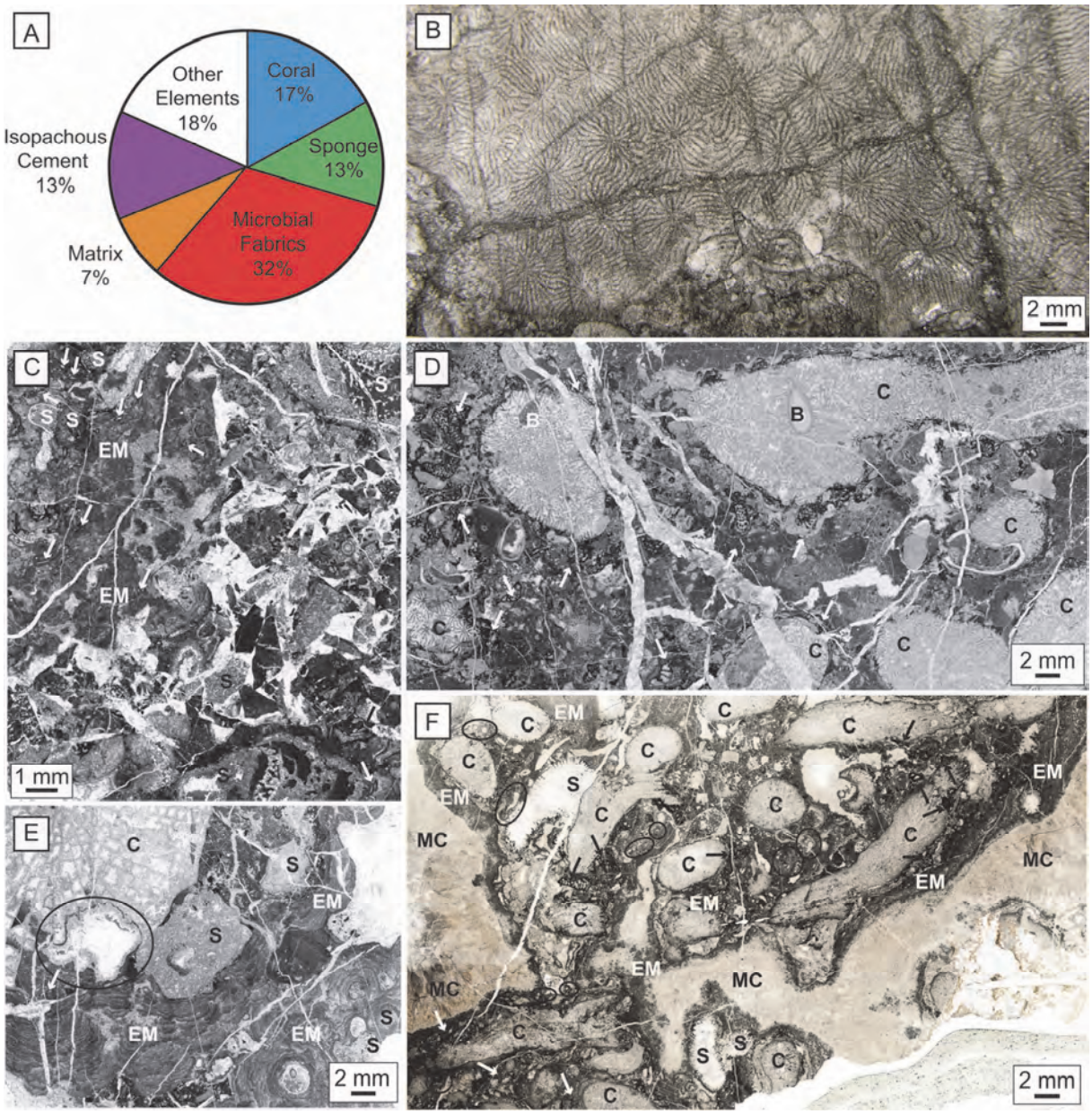

Fig. 20. The Gosausee reef front facies. A) Reef front facies composition based on mean values from point counting data (GS5, GS6, GS7, GS11, GS12, GS14, GS18, and GS19); B) Unnamed thamnasterioid coral (Genus 1) from site GS19; C) Brecciated microbial-sponge bindstone; many different sponges (S) occur in this sample, note the well-developed succession of epibionts in the top left corner, including sponges, encrusting sponges (*Uvanella* or *Celyphia*, black arrows), encrusting microbialite fabrics or algal crusts (EM), and *Microtubus* (white arrows). Sample from GS5, top of image is stratigraphic up, thin section photomicrograph (plane polarised light); D) Rudstone of a coral pillarstone, *Astraeomorpha* cf. *A. confusa* corals (C) are encrusted by *Alpinophragmium perforatum* foraminifera (white arrows, also rare *Radiomura* sponges and microbial fabrics), bored by lithophaginid bivalves (B), and then deposited in a muddy wackestone matrix; sample from GS7, thin section photomicrograph (plane polarised light); E) Microbial bindstone; large solitary coral (C), and sponges (S) encrusted by thick microbialite crusts (EM) and *Microtubus* (white arrows), there are also cavities with thin isopachous cements (acicular), crystal silt, and drusy calcite (circled). Sample from GS7, thin section photomicrograph (plane polarised light); F) Microbial bindstone; sponges and *Retiophyllia* cf. *R. oppeli* corals (C) are encrusted by microbialite fabrics (EM), *Alpinophragmium perforatum* and agglutinated foraminifera (black arrows), *Radiomura* sponges (circled), and *Microtubus* (white arrows). Sample is then coated with tan-colored marine cements (MC), sample from GS11, thin section photomicrograph (plane polarised light). From MARTINDALE et al. (2013).