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GEOLOGICAL NOTES ON PLANT MEGAFOSSIL LOCALITIES AT CERRO GUIDO, ULTIMA ESPERANZA, MAGALLANES (XII) REGION, CHILE

Atsushi Yabe[1], Kazuhiko Uemura[2], Harufumi Nishida[3], and Toshihiro Yamada[2]

[1]Fukui Prefectural Dinosaur Museum, 51-11 Terao, Muroko, Katsuyama, Fukui 911-8601, Japan
E-mail: a.yabe@dinosaur.pref.fukui.jp
[2]National Science Museum, Tokyo 169-0073, Japan
[3]Chuo University, Tokyo 112-8551, Japan

The Late Cretaceous to Tertiary deposits with plant megafossils crop out along the Chile-Argentina border of Patagonia, southern South America (e.g., Romero, 1986). Despite their importance in discussing the origin and history of South American floras, paleobotanical studies in Chile have made little progress since their discovery in the late 19th century (Tanai, 1981). The late Professor M. Nishida conducted a series of research expeditions to Chile and Bolivia to resolve the problem (Nishida, 1981, 1988, 1991). His party visited possible Maastrichtian fossil localities at Cerro Guido in the Ultima Esperanza District (Hauthal, 1899; Berry, 1937; Florin, 1940; Hunicken, 1971) during 1979 and 1987 (Nishida, 1981, 1988). Tanai (1981) presented the stratigraphic framework of the locality but the fossil composition, occurrence, and complete sequence of the formation have never been detailed.

We visited the locality for 2 days in January 2003 to obtain additional geological data. Although identification of associated molluscs and trace fossils is not yet finished, we describe the stratigraphic information of the plant fossil locality at Cerro Guido. Plant megafossils of the formation are described elsewhere.

Geologic settings

The Late Cretaceous and Tertiary strata of the Ultima Esperanza district are deposits of the Magallanes foreland basin (Austral basin in Argentina) formed in relation to Andean compressional orogenesis (e.g., Wilson, 1991; Fildani *et al.*, 2003). The basin extends approximately north-south across the border between Chile and Argentina. It was filled by north-south progradation of depositional environments (Macellari *et al.*, 1989) with sediment transported consistently southward in the mid-Cretaceous, and dominantly eastward in the Late Cretaceous and Tertiary (Wilson, 1991). These deposits in the basin constitute hilly ranges running generally NNW-SSE between the Patagonian Cordillera and Pampas.

The stratigraphy of the Ultima Esperanza District was outlined first during early scientific expeditions to South America followed by the comprehensive work of Feruglio (1949-50). More recent intensive geological studies of the district have been carried out by ENAP (Empresa Nacional del Petróleo) (e.g., Cecioni, 1957a, b; Katz, 1963; Natland *et al.*, 1974;

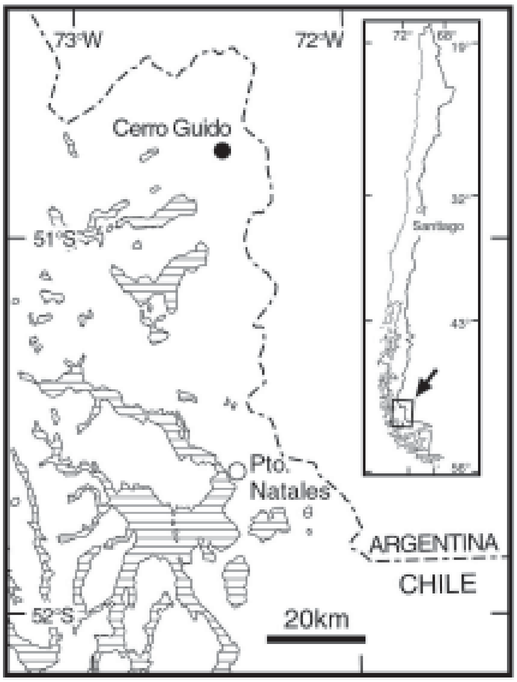

Fig. 1. Index map of Cerro Guido, approximately 90 km north of Puerto Natales, Ultima Esperanza, southern Chile.

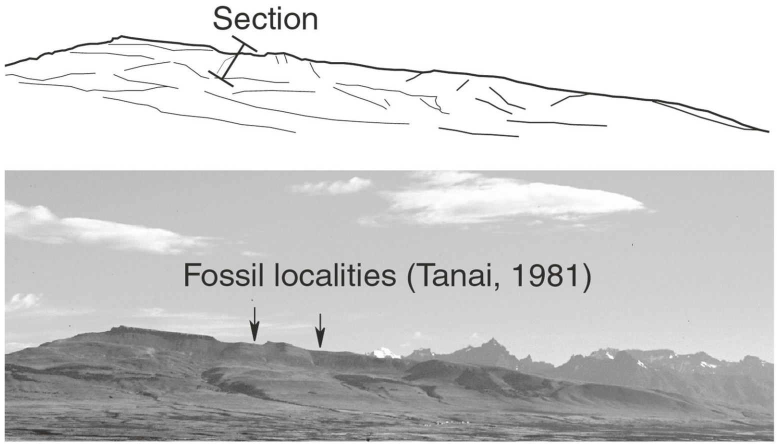

Fig. 2. Overview of Cerro Guido, showing localities of plant megafossils reported by Tanai (1981) and stratigraphic section for this study.

ENAP, 1978). According to these works, the Upper Cretaceous comprises three formations in ascending order: the Cerro Toro, Tres Pasos, and Dorotea formations. The Cerro Toro Formation is deep-sea fan deposits (Winn and Dott, 1979) and is assigned a Cenomanian to Campanian age (Wilson, 1991). The Tres Pasos Formation is a transitional facies between deep sea and shallow marine sediments, and the overlying Dorotea Formation is deposited above the wave base (Macellari, 1988). The Tres Pasos Formation is usually assigned a Campanian age, while the Dorotea Formation is considered Maastrichtian (Katz, 1963; Malumián and Caramés, 1997).

Cerro Guido is a hilly mountain at the eastern end of the Sierra Contreras located approximately 90 km north of Puerto Natales (Fig. 1). The east-to-west running mountain ridge is capped by hard sandstone beds that dip gently eastward (Fig. 2). The southern flank of the mountain has a steep slope consisting of the Dorotea Formation, which is the main objective of the study. The underlying Tres Pasos Formation crops out along the valley halfway up the mountain; it comprises well-stratified mudstone intercalated with fine- to coarse-grained sandstone containing abundant fragments of plant and trace fossils. The contact between the Tres Pasos and Dorotea formations is unclear.

Stratigraphy of the Dorotea Formation at Cerro Guido

The Dorotea Formation reaches about 150 m in total thickness at the southern flank of the mountain (Figs. 2 and 3; GPS data at plant megafossil locality 1: 50°53.70’S, 72°27.29’W, 1111.6 m asl). It consists predominantly of greenish-gray sandstone of possible shallow-marine origin intercalated with carbonaceous mudstone, coal, and occasional conglomerates. The basal part of the section (unit 1) comprises alternating beds of dark-gray mudstone and sandstone with rare conglomerates. The sandstone is characterized by trough cross-stratification and contains ammonite and bivalve shells. The fossil-bearing bed in this unit is calcareous and forms a small cliff. It probably corresponds to “concrezioni calcareo-arenose” (= calcareous sandy concretions) in the lowest sandstone of the Dorotea Formation reported by Cecioni (1957: p. 15). The middle part of the section is mainly composed of fine- to very coarse-grained sandstone and granules with intercalation of carbonaceous mudstone, sandstone, and coal at unit 5. The sandstone of unit 2 is characterized by parallel lamination occasionally intercalated with thin red conglomerate layers that are compacted. Unit 2 is overlain by bioturbated fine-grained sandstone of unit 3 that yields occasional shell fragments. Sandstones in units 4 and 6 generally exhibit trough cross-stratifications. Unit 7 consists of black mudstone with interbeds of fine- to medium-grained sandstone and contains brackish bivalves (mainly oysters) and numerous plant megafossils. Unit 8 is composed of coal and carbonaceous mudstone with root traces (Fig. 5-6). Unit 9 comprises alternating beds of sandstone, mudstone, and conglomerates. The thickness of each bed changes laterally with some lenticular mudstone (Fig. 5-7). This unit makes up the cap rock at the mountain top while units 7 and 8 form the col between two peaks.

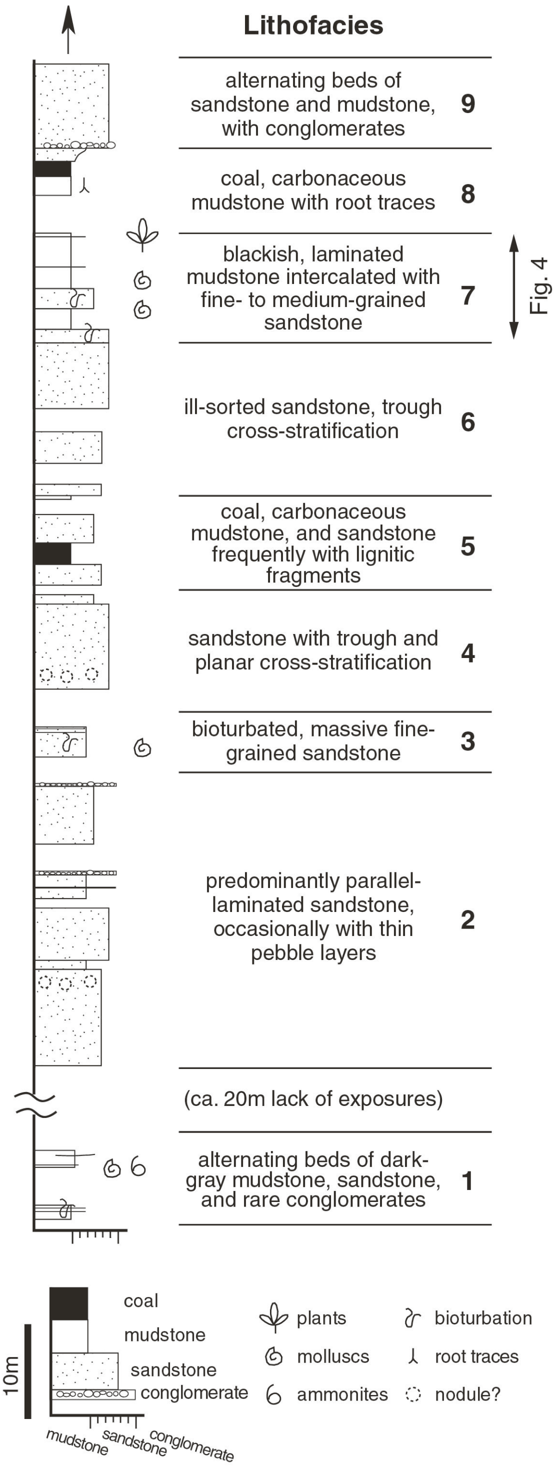

Fig. 3. Columnar section of the Dorotea Formation at Cerro Guido. The uppermost part of the section approximately 15 m thick was omitted.

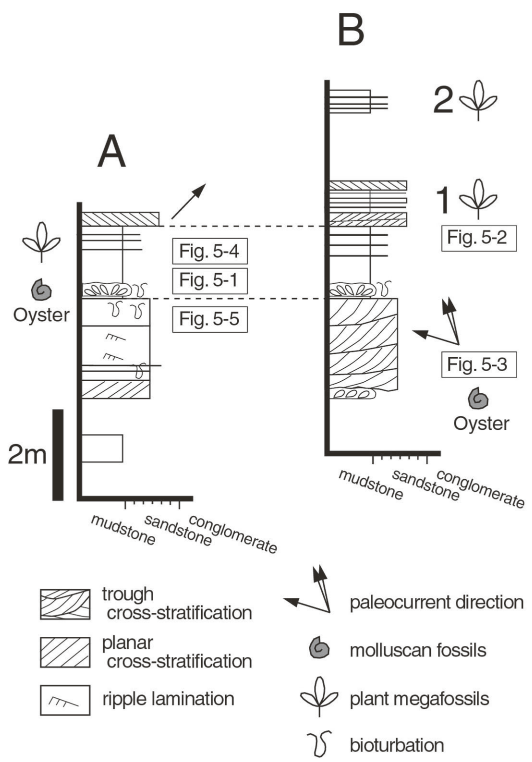

Fig. 4. Detailed columnar sections around the plant megafossil localities of the Dorotea Formation. Section A locates approximately 10 m west of section B.

Depositional facies and environment of plant megafossil localities

Figure 3 shows details of the depositional facies near the plant megafossil localities in unit 7. Examples of plant megafossils from this unit are shown in Fig. 6. The plant megafossil localities (1 and 2) are close to one of the two localities reported by Tanai (1981: p. 26) (Fig. 2) and are regarded as the same stratigraphic horizon.

The unit consists of black, laminated mudstone with interbeds of fine- to medium-grained sandstones (Fig. 5-4). Oyster fossils were recognized as two lenticular beds within the mudstone. Oyster shells lay parallel and/or oblique to the bedding plane and are sometimes attached to each other to form colonies (Fig. 5-1). The beds are 20-30 cm thick and the upper one can be traced about 50 m east from section A (Fig. 5-7). The sandstone bed between the two oyster beds is characterized by trough cross-stratification at section B (Fig. 5-3). It changes laterally into ripple laminated sandstone and bioturbated sandstone where vertical cylindrical burrows are recognized (Fig. 5-5). Paleocurrent directions indicate mostly landward (west to north-west) sediment transport. Plant megafossils are recognized in thin laminated mudstone or sandy mudstone, which is intercalated with brown sandstones (Fig. 5-2; Fig. 6). One paleocurrent datum obtained from the planar cross-stratifications suggests comparatively seaward sediment transport.

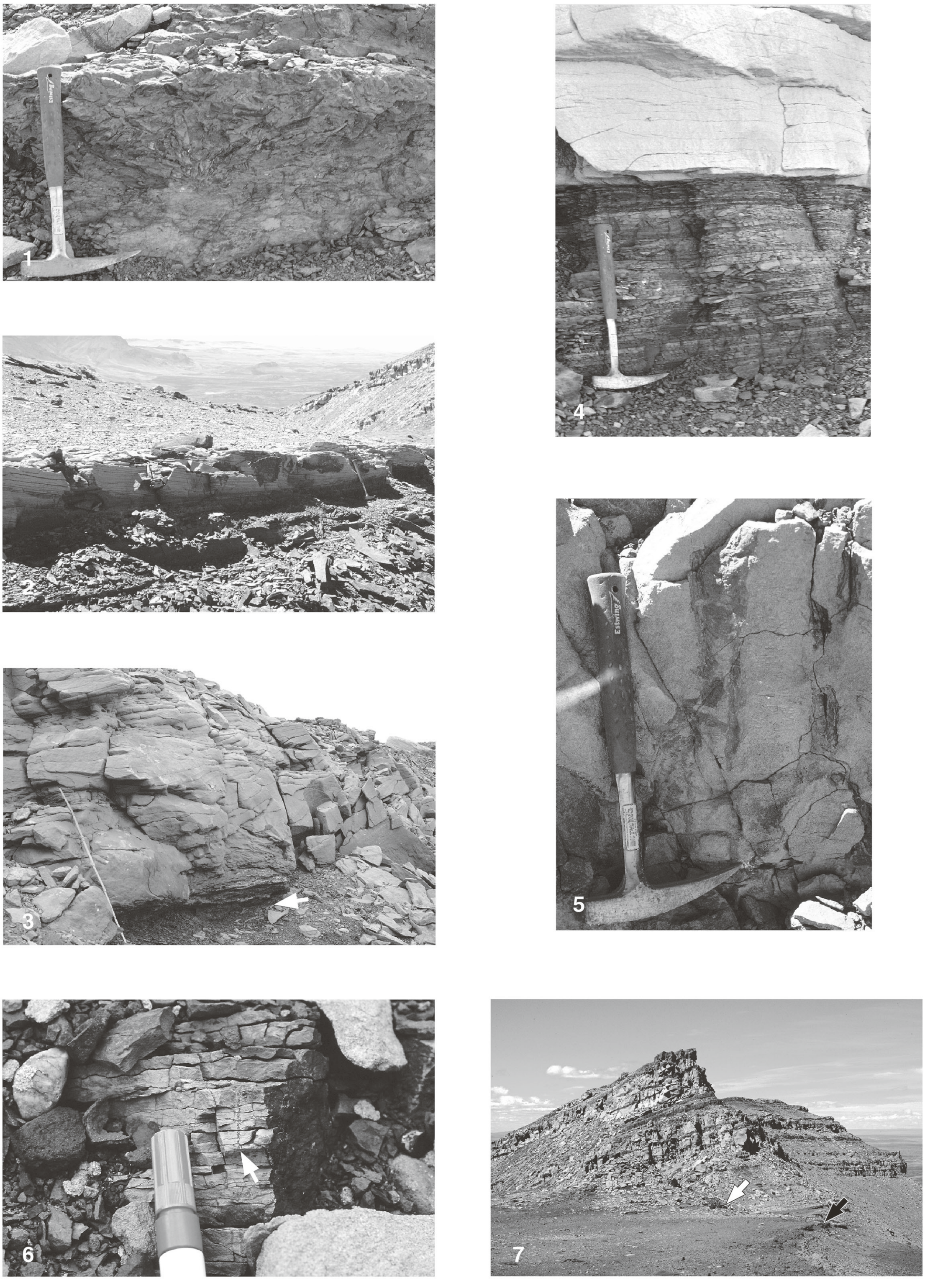

Fig. 5. 1, Close-up view of the upper oyster bed; 2, Plant megafossil locality 1; 3, Sandstone between two oyster beds, which is characterized by trough cross-stratification. Arrow represents lower oyster bed shown in Fig.4B. Scale equals 1 m; 4, Lagoonal facies represented by thinly laminated mudstone and sandstone; 5, Vertical, cylindrical burrow found in unit 7. Just below the upper oyster bed at Fig. 3A; 6, Root trace at unit 8 (arrow). A pen cap for scale is 2.8 cm long; 7, Overview of the upper part of the Dorotea Formation, east of plant megafossil localities 1 and 2. Solid arrow indicates upper oyster bed, and an open arrow represents plant-bearing beds. Hammer for scale has a handle 30 cm long (Figs. 5-1, 2, 4, and 5).

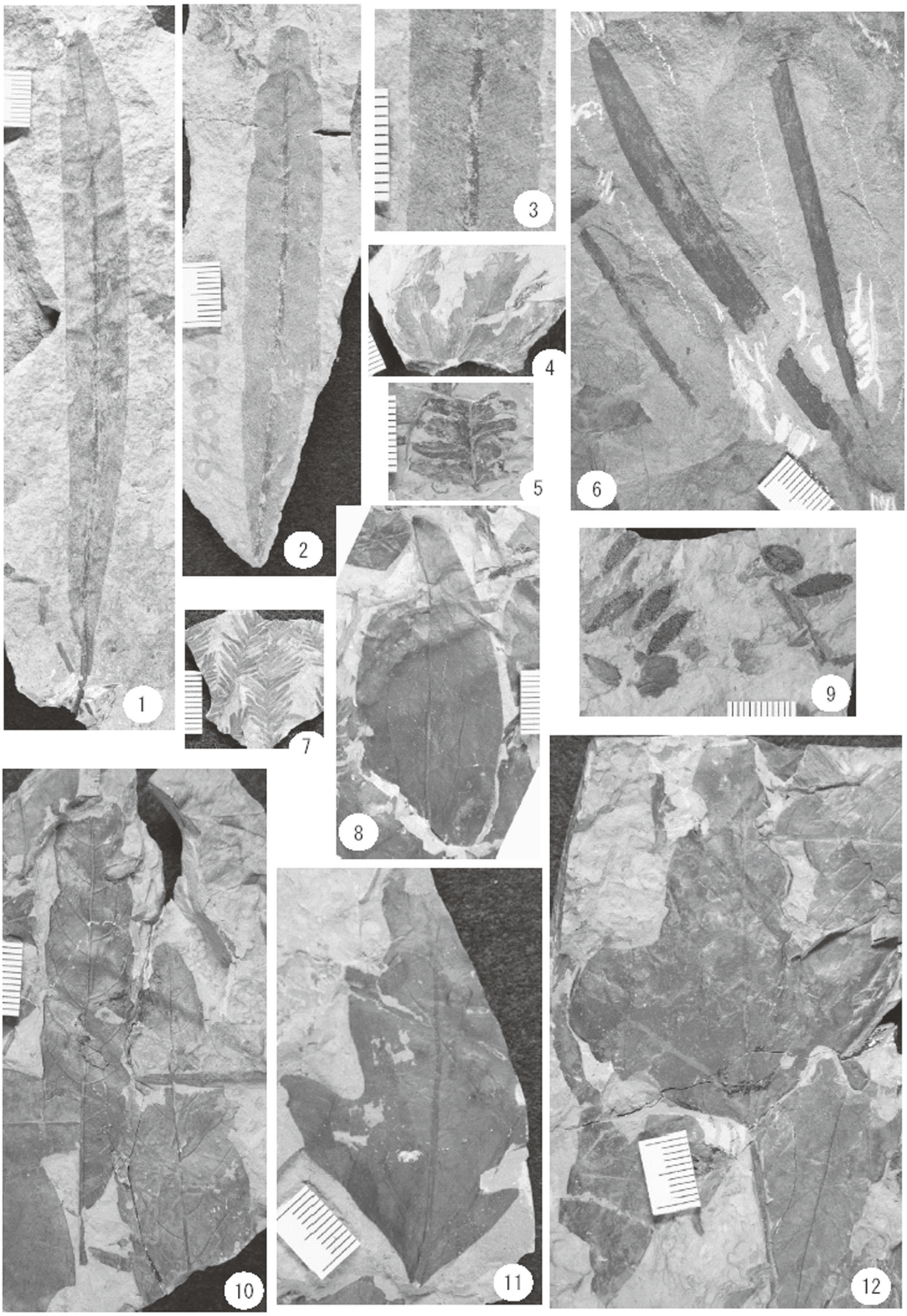

Fig. 6. Selected plant megafossils from the Dorotea Formation at Cerro Guido.
1, *Taeniopteris* sp., CG-1; 2, 3, *Taeniopteris* sp., CG-2. Fig. 6-3 is enlargement of Fig. 6-2; 4, *Lygodium* sp., CG-3; 5, *Cladophlebis* sp., CG-4; 6, Gingoalean? leaves, CG-5; 7, *Podocarpus* sp., CG-6; 8, *Menispermites* sp. cf. *M. piatnitzkyi* Berry, CG-7; 9, Unidentified fruits, CG-8; 10, Dicot with simply serrated margin, CG-9; 11, Dicot with lobed margin, CG-10; 12, "*Sterculia*" *sehuensis* Berry, CG-11; Scale in mm.

The depositional facies of the unit as well as the oyster colonies suggest a brackish lagoon environment. Plant-bearing mudstones and sandstones overlain by possible salt marsh deposits (unit 8) are interpreted as deposits of a tidal-flat environment.

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