UNPUBLISHED REPORT 1966/13

Pipers River area Tertiary sediments and recent gravels

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GENERAL SETTING

Hills composed of Silurian sediments, the Mathinna Beds, forming the major part of the Pipers River area, give way in the southeast to granite terrain, and in the east to countryside of poorly consolidated sediments of Tertiary age, overlying a granite base. Flat-topped hills of both granite and Tertiary sediments locally carry a capping of basalt.

GEOLOGICAL HISTORY

Invasion by granite in Devonian times indurated the Silurian sediments adjacent to the contact, increasing their resistance to erosion. Subsequent selective weathering and removal of granite formed a considerable depression in the east, leaving the indurated Mathinna rocks as an upstanding western lip, forming a ridge from The Sideling north through Bridport, and beyond to East Sandy Cape.

The elongate depression in granite basement, in which Tertiary sediments accumulated, probably reaches its maximum depth towards the eastern margin of the area mapped, and received the major part of its detrital filling from rivers draining the granite country locally and to the south. The position of a small exposure of granite, recently located some half-mile south of the present mouth of the Great Forester River, suggests that towards the coast granite persists at shallow depth between Bridport and the Great Forester, and that the major drainage outlet from the depression in early Tertiary times lies further east. The nearest known solid-rock outcrops in that direction are small granite 'whalebacks' four miles east of the Great Forester mouth, and beyond that low hills of indurated Mathinna sandstones, apparently the eastern lip of this local basin. Another indication of the form of the floor of the depression is provided by the granite bedrock known to outcrop sporadically in the bed of Tuckers Creek as far north as four miles north-northeast of Jetsonville.

A substantial rise in sea level of some hundreds of feet in Tertiary times threatened a progressive inundation of the floor of the depression, to form a shallow bay. Vigorous erosion and redistribution of granite debris on the subsiding coastal platform occurred under youthful deltaic conditions, with deposition possibly as a number of 'piedmont' fans discharging onto the partly submerged floor. A degree of balance was probably maintained between rise in sea level, and rapid deposition of sediments.

The shallow basin became the depository for a great volume of rather uniform, poorly-sorted detritus composed essentially of the same minerals, in much the same proportions, and of grain-size only slightly reduced from that of the parent granite. Beds of clay, cleaner sand and grit horizons appear in the succession, and gravels and cobbles of Mathinna sandstone and vein quartz are associated with the old river courses. The most common sediment type is coarse grit of sub-angular quartz granules with an abundant, variegated, frequently micaceous clay cement.

Late(?) Tertiary basalt extrusion filled shallow depressions in the surface of the sediments and flooded the surrounding countryside. Subsequently solutions rich in iron (leached from the basalt) cemented grits and gravel immediately beneath, forming layers markedly resistant to weathering. Ultimate recession of the sea inaugurated a new erosional cycle, but rapid and accurate exhumation of the pre-Tertiary landscape was prevented by the extensive protective capping of basalt and hard ferruginous sandstone and grit.

NATURE OF SEDIMENTS — STYLE OF EXPOSURE

In this district the weathering of granite rocks 'in situ' results in the alteration of ferromagnesian minerals and feldspars to clays, and leaves quartz relatively unaffected. Usually an igneous texture remains, more or less pronounced, relic mica flakes can be recognised and discrete pellets of clay representing individual feldspar crystals can be isolated. Soils overlying this material contain variable concentrations of quartz granules related in size directly to the quartz grains in the granite.

Erosion, limited transport and redeposition of granitic material, in units of single crystals or aggregates of crystals, has produced sediments which on further weathering appear superficially similar to rotten granite, and difficulty is occasionally experienced in distinguishing between them in regions of poor exposure. Fortunately sedimentary structures are frequently present, albeit poorly expressed, and sedimentary textures can usually be recognised. Soils overlying sediments composed of granite detritus contain similar high concentrations of sub-angular quartz granules as soils overlying granite bedrock. In both circumstances lag deposits of quartz-granule gravels locally attain several feet in thickness and are exploited for building material.

In terrain composed of granite and Tertiary sediments overlain by a basalt capping, poor consolidation and cementation of Tertiary sediments results in their producing steeper-sloping valley sides than does the granite. This geomorphological distinction (well demonstrated about Lietinna), can be recognised both on the map and in the field. Natural exposures of these sediments are rare, despite the steep slopes they frequently produce. Other evidence used in delineating their outcrop includes the float of quartz and Mathinna sandstone pebbles (often extremely sparse); a small proportion of rounded grains in the ubiquitous quartz granule float; occasional flaggy blocks of grit with ferruginous or siliceous cement; and the complete absence of granite outcrop or float throughout the area.

Man-made exposures are not uncommon and a series of road and rail cuttings provide information where routes west from Scottsdale cross outcrops of Tertiary sediments in the vicinity of Lietinna. Farming operations provide abundant float evidence west and southwest of West Scottsdale. Further road cuttings between Scottsdale and Bridport are amplified by numerous road-materials pits on the minor road between Jetsonville and West Scottsdale. North of Jetsonville exposure is poor on the lower ground but upstanding ferruginous cappings demonstrate a variety of types of sediment on the hilltops.

Part of a major Tertiary valley system has been recognised, aligned roughly north-south through Lietinna and West Scottsdale. With tributaries draining an area including the steep eastern slopes of the hills near The Sideling, composed of Mathinna sandstones, this Tertiary river system deposited distinctive types of sediment. The close-spaced joint fractures apparent in outcrops of Mathinna rocks, produce blocks pre-disposed to weather into cobbles, commonly ovoid, oblate or discoidal, and with diameters ranging from 2" to 8". These are usually accompanied by smaller, less perfectly-rounded pebbles of vein quartz.

LOCATION AND INFORMATION FROM SPECIFIC EXPOSURES

One and a half miles west of Springfield a basalt-capped ridge displays an extremely steep easterly slope into a valley with sparse granite outcrops along the course of the river. Sediments preserved between granite and basalt produce a copious float of quartz and Mathinna sandstone pebbles. Springs arise along the line of sediment outcrop and their streams have produced a series of small 'amphitheatre' hollows, with steep walls and floors sometimes marshy with abundant tree-ferns, and elsewhere covered with fans of gravel, largely of quartz material. Sub-angular quartz boulders attain diameters of 6"; more perfectly rounded Mathinna sandstone averages some 4" in diameter. Debris produced by post-hole digging in the vicinity shows a predominance of 3", perfectly ovoid or disc-like sandstone boulders, highly weathered and inclined to disintegrate along the cleavage planes.

One and a quarter miles south of the Lietinna road-rail crossing, the road forms a sharp hair-pin bend round a small ridge of unconsolidated Tertiary grit and gravel. The Scottsdale council operates a quarry

for road-fill at this site, which exposes some 20’ of sediments overlain by 4’ of soil rich in quartz granules. The tallest vertical face displays some 2’ of uniform quartz grit with clay cement and rare 1” quartz pebbles, overlying a 2’ pebble bed of Mathinna sandstone cobbles averaging some 2”–4” diameter with subordinate smaller sub-rounded vein quartz. Beneath, a 3’ bed of coarse sand, clay and grit contains discontinuous horizons of 1” diameter pebbles, and below this again large rounded pebbles are dispersed in a grit and clay matrix.

Two hundred yards north of the Lietinna road-rail crossing, a new road alignment has resulted in cuttings displaying a 6’ thickness of coarse cobble bed of perfectly rounded Mathinna sandstone fragments with diameters to 8”, close packed, with rare 2”–3” quartz discs in a matrix of clay and quartz granules. This is overlain by at least 6' of coarse quartz-granule grit with clay matrix, and current-bedded fine-grained sandstone, on a base with a slight northerly component of dip.

Recent road widening has resulted in recutting a series of high banks in Tertiary sediments in the valley side one and a half miles east of the Lietinna road-rail crossing. The largest face extends for 50’ and attains a height of over 15’. The lowest bed, composed of pale clay with abundant included quartz granules, is overlain in turn by some 5’ of uniform coarse granule grit; some 4’ of pale sandy clay with clay lenses; and an upper grit bed which merges into the overlying basalt soil. Lenses of slightly coarser material among the lower grits attain a thickness of 6” and a length of 4’, and include rare clay pellets and buttons of Mathinna sandstone. A disrupted clay bed among the pale sandy clays forms discontinuous sinuous lenses some 8” thick and 2½’ in length. This irregularity, and the boldly undulating interfaces between successive beds, are attributed to contortion during compaction of the sediment while still waterlogged, possibly at the time of basalt extrusion.

The railway cutting half a mile northeast of the Lietinna road-rail crossing, shows 10’ of variegated ochreous and white clays with dispersed quartz granules overlain on a gently undulating surface by 20’ of rusty-red grits and sands with clay matrix, and a dip component of 1° or 2° to the south. The regularity of the lamina bedding is only interrupted by occasional lenses of current bedding some 6” deep and 18” long.

Pronounced current bedding on a larger scale, with units 8’ long and internal structure emphasised by deposition of iron-ore from percolating groundwater, occurs in the face of a road materials pit, three quarters of a mile north-northeast of the road-rail crossing at Lietinna. The coarse grits have fragments rarely exceeding ½” diameter.

A similar range of sediments is less well exposed in road cuttings on the Scottsdale–Bridport route. Undulating boundaries between successive beds can be related to either ‘washout and fill’ structures or compaction effects in waterlogged material. Occasional horizons of Mathinna sandstone pebbles are exposed, but the only major outcrop of cobbles forms a slight rise to the north of the alluvial flats, five miles northwest of Jetsonville. The extensive pebble sheet on the rising ground to the east of the flats is probably derived as a lag deposit from the same pebble bed.

THE NORTHERN LIMIT OF TERTIARY SEDIMENTS — GEOMORPHOLOGY

The northern margin of the Tertiary sediment outcrop only forms a well defined feature against the northern gravel plains at the eastern margin of the area, and again near the Scottsdale–Bridport road. The boundary is completely obscured by copious hill-slope wash of fine material from the sediments, and a veneer of blown sand. Lithology and topographical expression of the more recent gravels are quite different, and unlike the Tertiary sediments, which generally support rough eucalypt and *Casuarina* forest, the gravel plains are almost devoid of scrub forest. The hills six miles north of Jetsonville rise sharply from 100’ on the plain to 300’ on iron-cemented grits at the summit, to form an isolated ‘butte’ overlooking the valley of Tuckers Creek. To the east a more extensive ‘mesa’ of Tertiary sediments with ferruginous capping occupies much of the interfluve between Tuckers Creek and the Great Forester River, rising to a height of over 400’ seven miles northeast of Jetsonville.

The withdrawal of the sea since late Tertiary times left no well-developed features relating to pauses in the recession. The change of topography, from undulating hills of Tertiary sediments to gently shelving gravel plains of more recent origin, probably indicates the limit of re-encroachment of the sea at a later date. The northern limit of Tertiary sediments may, in fact, represent the retreat-scarp of a quite recent shoreline.

QUATERNARY GRAVELS — GEOMORPHOLOGY

It appears that the gravel deposits consist of material derived by erosion mainly from Tertiary sediments by the sea; reworked, sorted and redeposited in shallow water on the marine-cut platform. A drop in sea level of some 20' and subsequent re-encroachment resulted in the production of a second marine-cut platform at a lower level, separated from the upper terrace by a low, but abrupt cliff. The process was repeated with a second 20' drop in sea level, and production of a lower platform. Where the scarps, representing the inland limit of encroachment after successive recessions of the sea, happen to coincide, a substantial cliff of gravel is preserved, as occurs one and a half miles south-southeast of the mouth of the Great Forester River.

With the development of a continuous bank of sand dunes along the coast, blocking the northerly outlet to the sea, the lowest marine platform has become an extensive flood plain for the Great Forester River, which flowed westwards behind the dunes and into the sea at Bridport. Floods in this area have resulted in the deposition of a continuous cover of silty alluvium over the gravels, the latter now being exposed in some of the deeper drainage ditches, A man-made cut allows the river's escape through the dunes, to remove the threat of periodic flooding, in the interests of the agricultural community. Perched marine terraces show their best development east and southeast of Bridport, and again two miles north of Bridport in the Noland Bay area, but corresponding river terraces can be recognised in the valley of the Little Forester River, three miles west of Bridport.

NATURE OF OUTCROP AND INFORMATION FROM SPECIFIC EXPOSURES

The level, poorly-drained areas of the flats support patches of marshland, and elsewhere are composed of fine sandy soil; part, at least, ascribed to a wind-blown origin. Farming activities reveal that fine gravels are extensive at shallow depth. The float derived consists of small quartz pebbles, contrasting with the granules from the Tertiary sediments further south in the perfection of their rounding, and their size range from $^{1}/_{16}$" to ½" diameter.

Again the best exposures are man-made and consist of gravel pits and bulldozer cuts. Gravels are well exposed on an isolated knoll, and on the farm track up the cliff, one mile and one and a half miles respectively south-southeast of the mouth of the Great Forester River. At the latter site a succession of some 30' of gravels can be demonstrated, with beds of fine sand including sub-angular to rounded quartz granules to ½" diameter, and rare dispersed rounded quartz pebbles to ½" diameter. Lower in the sequence impersistent gravel beds appear more frequently, ranging in thickness from 1" to 18", and composed of well-rounded pebbles, loosely packed in a matrix of grit and sand. Often the pebbles in individual horizons are well sorted. Occasional current-bedded units attain lengths of 6' and thicknesses of 18", with structure emphasised by selective iron staining. Throughout, the sequence is devoid of clays.

Gravel for road foundations has been obtained from pits one mile east-southeast, and one and a half miles south-southeast of the junction of the Scottsdale and Waterhouse roads at Bridport. At the first pit the deposits are variable with the most persistent beds of grit and sand attaining thicknesses of between 1' and 2', and including minor discontinuous bands of ¼" pebbles. Lensoid beds of coarser gravel, 6" thick, are composed of subrounded, discoidal and oblate pebbles of vein quartz and rare Mathinna sandstone and slate, averaging about 1" diameter, but occasional 4" pebbles are present. Lenses of coarse grit 1" long and 3" wide are common, as are local patches of rusty iron cementation.

The larger pit, one and a half miles down the Scottsdale road from Bridport, shows equally variable deposits. Usually bedding is persistent in units varying in thickness from 2” to 2’. Fine sands and grits are interleaved with gravel beds of pebbles rarely exceeding 2” in diameter and conspicuous for the perfection of their rounding. Vein quartz material predominates, but pebbles of Mathinna sandstone and slate are abundant, and two unusual 1” subangular fragments (displaying remnants of polyzoan fossils) are ascribed to the Permian, although their source remains a matter of conjecture. Massive beds of ill-sorted material and beds of coarse gritty sand show yellow and black patterns of iron-staining. Rare sub-angular 4” blocks of Mathinna sandstone are referred to a local origin. Another face of the quarry shows unbedded, well-compacted beach or dune sand overlain by discoidal quartz and sandstone pebbles. This section shows a deep washout gully infilled with a layered ‘birds-eye wash’ of fine, perfectly rounded quartz pebbles.

It is significant that no clay lenses occur and no clay-cemented beds are exposed among the Quaternary gravels.

[May 1966]