MOUNT EGERTON 1:250 000 MAP SHEET, WESTERN AUSTRALIA

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INTRODUCTION

The MOUNT EGERTON 1:250 000 map sheet area lies between latitudes 24°00' and 25°00'S, and longitude 117°00' and 118° 30'E, some 300 km east of Carnarvon. The following discussion of the geology, physiography, soils, vegetation and regolith of this area is taken from explanatory notes for the MOUNT EGERTON 1:250 000 map sheet (Morris *et al*., 1998), which forms part of the Geological Survey of Western Australia's (GSWA) regional regolith geochemistry program. This program, which began in 1994, provides information on the distribution and composition of regolith derived from remotely sensed data (e.g. Landsat TM, aerial photography), field observations and multi-element analyses of regolith from about 1 000 sites, equating to a site density of 1/16km^2. The scope of the project is discussed in all sets of explanatory notes (e.g. Morris *et al*., 1998 for MOUNT EGERTON).

PHYSICAL SETTING

Geology

MOUNT EGERTON lies in the Capricorn Orogen (Tyler and Thorne, 1990; Tyler *et al*., 1998), a sequence of largely Proterozoic rocks that were deformed following collision of the Archaean Pilbara and Yilgarn cratons. Two broad lithological associations can be recognised on MOUNT EGERTON (Figure 1). One comprises a sequence of Archaean–Proterozoic metamorphic rocks of the Gascoyne Complex, which are found in the southern part of the map sheet. The other association is a younger sequence of Proterozoic rocks of the Bangemall Supergroup (Martin and Thorne, 2001), which comprises about 90% of the map sheet area. Gascoyne Complex rocks include granitoids, gneiss, metamorphosed siliciclastic and calc-silicate rocks, and amphibolite (Muhling *et al.*, 1978). The overlying Bangemall Supergroup rocks are dominantly siliciclastic sedimentary rocks, ranging from conglomerate through to shale and mudstone. Other lithologies include dolomite and chert. Dolerite sills are extensively developed in the Bangemall Supergroup in the northern part of the map sheet. Comprehensive discussions on the geology of the region are given in Muhling and Brakel (1985), Chuck (1984), Williams (1990) and Cooper *et al*. (1998).

Geomorphology and soils

Upland areas are well developed in both the northern and southern parts of the map sheet, with the highest point (Mount Egerton; 994 m above sea level) being about 500 m above the level of drainage (Muhling *et al.,* 1978). In the northern part of the map sheet, strike ridges of dolerite are separated by broad valleys over sedimentary rocks. A similar ridge and valley morphology occurs over some Archaean–Proterozoic rocks in the southern part of the map sheet. Colluvial slopes and plains are usually found close to major drainages, whereas the three major river systems (Ashburton, Lyons, and Gascoyne rivers) form broad watercourses characterised by sandy deposits and locally developed calcrete and hardpan.

In upland areas, soils are skeletal and poorly developed (Beard, 1981), whereas plains support sandy material with a low clay content. Hardpan, which is locally developed, is underlain by silica-rich units at depth.

Climate and vegetation

The arid–semi-arid climate of MOUNT EGERTON is characterised by low rainfall (200–250 mm/yr) and high evaporation (2400–2800 mm/yr) (Muhling *et al.,* 1978). Vegetation types range from hummocky grassland and scrub, through shrubland, to woodland (Aplin, 1977; Beard, 1981).

REGOLITH–LANDFORM RELATIONS

In the GSWA's regolith geochemistry program, regolith classification is based on the RED (relict–erosional–depositional) scheme of Anand *et al.* (1993) and Anand and Smith (1994). Although the scheme has evolved throughout the program, the fundamental approach to regolith classification has been preserved, using a set of primary letter codes to denote a landform position or process, qualified by a set of optional codes to designate composition and parent rock type. The current scheme, which is used on all regolith maps produced by the GSWA, is discussed by Hocking *et al.* (2001). A review of the status of the scheme during production of the regolith–materials map for MOUNT EGERTON is presented in Morris *et al*. (1998). Each of the primary landform/process codes can be subdivided according to composition and parent material. For example, depositional regime regolith (D) has been divided into several primary code categories, including C (colluvial), W (sheetwash), L (lacustrine), A (alluvial), and S (sandplain). A simplified regolith map for MOUNT EGERTON is shown as Figure 2, and the extent of different regolith units is summarised in Table 1.

Relict or residual regime regolith (R), which accounts for less than 2% of all regolith on MOUNT EGERTON, includes siliceous caprock, ferruginous duricrust, and quartz- and feldspar-rich regolith developed over sedimentary rocks. Siliceous caprock is generally developed on calcareous sedimentary units in the northern part of the map sheet, whereas ferruginous duricrust is generally associated with dolerite. Almost half of the relict regime regolith consists

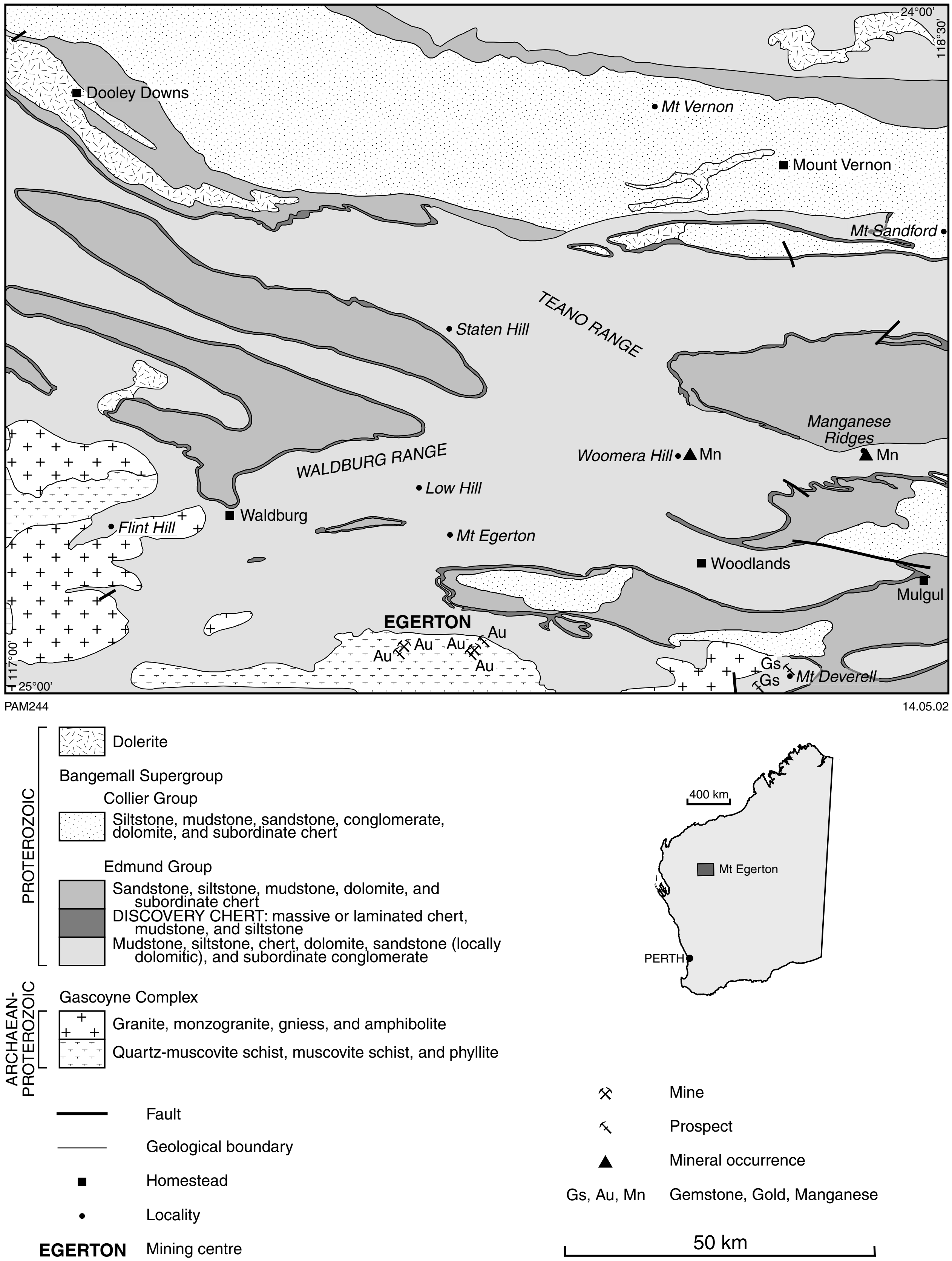

Figure 1. Generalized geological interpretation of the MOUNT EGERTON 1:250 000 sheet. (after Cooper *et al*., 1998)

of quartz- and feldspar-rich material developed over Proterozoic sandstone in the central northern part of the map sheet.

Exposed regime regolith (X), which broadly corresponds to areas of outcrop, saprolite, or bouldery lag, accounts for almost half (49%) of the regolith on MOUNT EGERTON. Most of this regolith type (66%) is derived from the breakdown of quartz- and feldspar-rich sedimentary rocks and is especially well developed in the central–eastern, northern, and central–southern parts of the map sheet, broadly corresponding to siliciclastic sedimentary rocks of the Bangemall Supergroup. Twelve percent of exposed regime regolith (or 6% of total regolith) is carbonate-rich, derived from dolomitic rocks of the Bangemall Supergroup. A similar amount of exposed regime regolith comprises ferromagnesian-rich material spatially associated with dolerites in the northern part of MOUNT EGERTON.

Table 1. Extent of regolith types developed on MOUNT EGERTON.

CATEGORY	AREA (%)
Relict or residual regime regolith	
Iron-rich duricrust	0.3
Silicified capping on sandstone	0.8
Silcrete	0.7
Total	*1.8*
Exposed regime regolith	
Ferruginised saprock, saprolite	0.2
Derived from quartzofeldspathic metamorphic rock	3.3
Derived from quartzofeldspathic sedimentary rock	32.3
Derived from carbonate-rich sedimentary rock	5.8
Derived from coarse-grained ferromagnesian rock	6.0
Derived from quartz-rich sedimentary rock	1.2
Total	*48.8*
Depositional colluvial regime regolith	
Derived from various sources	11.2
Derived from ferruginous rock	0.8
Derived from quartzofeldspathic rock	0.1
Derived from quartzofeldspathic metamorphic rock	1.4
Derived from quartzofeldspathic sedimentary rock	8.8
Derived from carbonate-rich sedimentary rock	1.7
Derived from coarse-grained ferromagnesian rock	1.3
Derived from quart-rich sedimentary rock	0.1
Hardpan	3.4
Weakly consolidated colluvium	2.6
Total	*31.4*
Depositional alluvial regime regolith	
Alluvium in active drainage channels	1.7
Lacustrine deposits	0.1
Undivided overbank deposits	5.7
Carbonate-rich overbank deposits	1.3
Sheetwash	9.2
Total	*18.0*

Approximately half of the regolith on MOUNT EGERTON is transported (depositional regime regolith, D). The most common type is poorly-sorted sand, silt and clay, locally with lithic clasts, which is found on slopes flanking outcrop. This unit comprises colluvium (C), which has been subdivided according to composition into, for example, ferromagnesian- and carbonate-rich members. However, in most cases (36% of all colluvium) this unit has been classified as undivided colluvium. Strongly ferruginous colluvium is found downslope from areas of dolerite, whereas areas of cemented colluvium (hardpan) are found in downslope areas adjacent to drainages.

Despite the development of three major drainage systems, alluvium in active drainage channels (A) accounts for only 2% of regolith on MOUNT EGERTON. In these drainage areas, overbank deposits (O) are the most common regolith type (7% of all regolith), comprising well-sorted sand to sandy clay-rich material which is locally saline. Carbonate-rich overbank deposits flank major drainage channels such as the Lyons River, or higher in the landscape within and on the margins of upland streams.

Low-energy sheetwash (W) deposits are intermediate to areas of colluvium and drainage channels, and usually merge with alluvial plains. This regolith type, which accounts for 9% of all regolith, is especially well developed in the central–western part of MOUNT EGERTON. Areas of aeolian sand (S) and lacustrine deposits (L) are poorly developed on the map sheet, accounting for less than 1% of the regolith, respectively.

DISCUSSION OF REGOLITH DISTRIBUTION

Widespread bedrock outcrop on MOUNT EGERTON is reflected by the abundance of erosional regime regolith (49%), with a similar amount of transported regolith. The small amount of relict regime regolith (2%) can be explained by the topographic variation in the map sheet area, which favours the erosion of lateritic weathering profiles.

There is a strong correlation between regolith type and bedrock lithology. This even extends to some types of transported regolith, such as ferromagnesian-rich colluvium found on slopes close to areas of dolerite, and quartz- and feldspar-rich colluvium in areas of similar relief occupied by quartzo-feldspathic sedimentary rocks. Although broad drainage areas are well developed on the map sheet, they are largely characterised by overbank deposits (some of which are carbonate-rich), with few active drainage channels.

REGOLITH CHEMISTRY

The 1 009 regolith samples collected from the MOUNT EGERTON map sheet area consist of 622 stream-sediment samples, 383 sheetwash samples, and four soil samples. The high proportion of

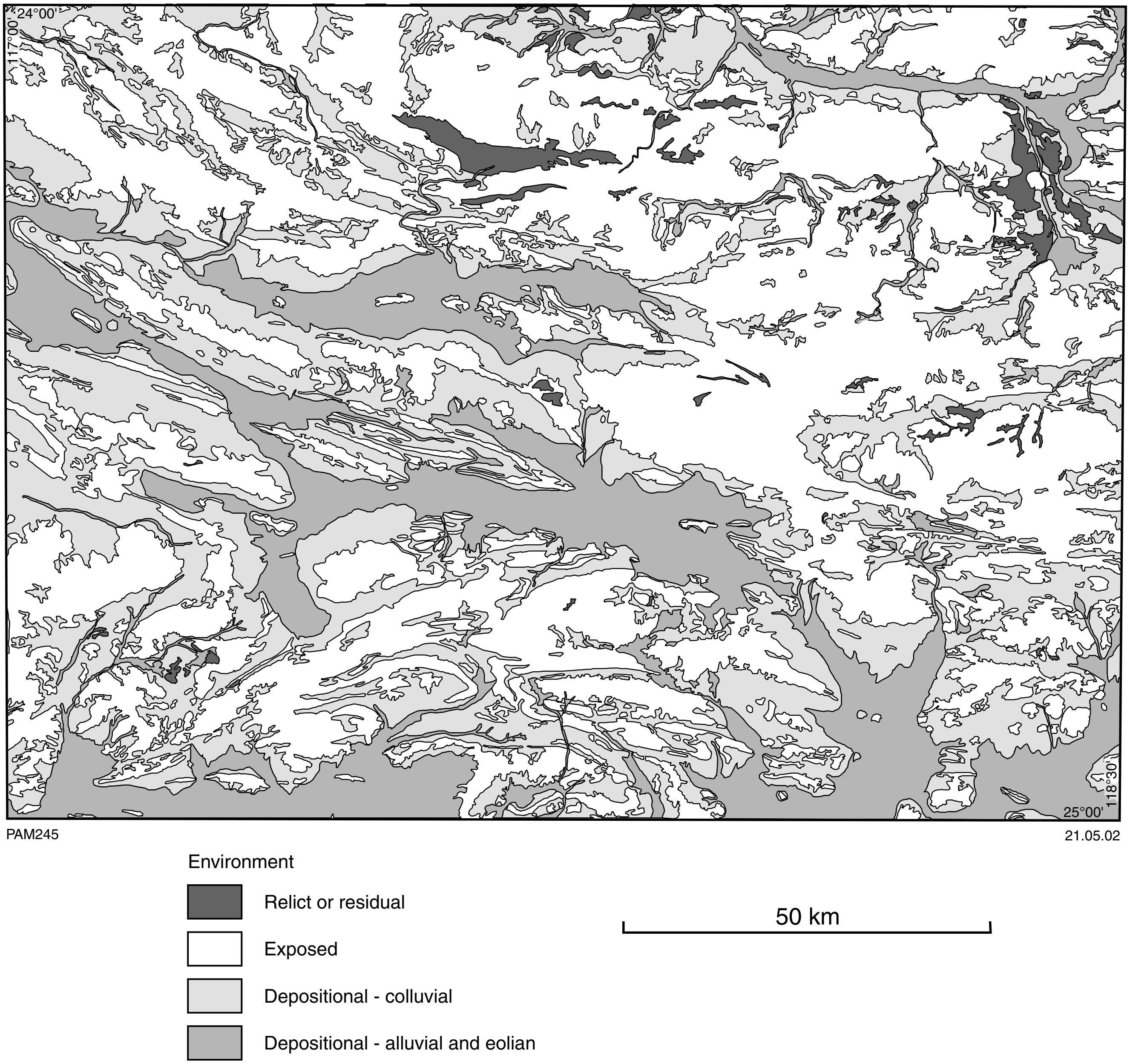

Figure 2. Generalized regolith map of the MOUNT EGERTON 1:250 000 sheet. (after Morris *et al*., 1998)

stream sediment samples is consistent with the amount of bedrock and relief of the map sheet area. Each sample was analysed for 47 components, as well as pH and conductivity. Analytical protocols and quality control procedures are discussed in Morris *et al.* (1998).

The chemistry of regolith results from the interplay of bedrock composition, and chemical and physical weathering. Strong lithological control on the chemistry of regolith is shown by the high TiO_2, V, and Sc content of regolith on or near areas of dolerite. In addition to these components, several samples have relatively high concentrations of Au and platinum group elements (PGE; Pd and Pt). A statistical comparison of regolith over different dolerite bodies shows that there are notable compositional differences, especially in MgO, CaO, Ni, Ba, Ce, and La concentrations, which may equate to different degrees of igneous fractionation. In some cases, there are differences in V, Sc, Cu, and Zn concentrations, which may equate to some units being more mafic, and having higher base-metal contents.

Bedrock control is also shown by relatively high concentrations of K_2O and Na_2O over granitoid rocks of the Gascoyne Complex, indicative of a high feldspar content. The geochemistry of regolith derived from the older gneiss and granitoid terrane of the Gascoyne Complex has been statistically compared with that of regolith from the younger schist and granitoid terrane. There are few compositional differences between these regolith groups, apart from their Na_2O and K_2O contents, although both have $K_2O/Na_2O > 1$.

In some cases, the composition of regolith reflects the effects of weathering and erosion, with little discernible bedrock control, such as the higher levels of CaO and loss-on-ignition values in carbonate-rich regolith developed over some Bangemall Supergroup lithologies. This material occasionally has elevated Au contents, which could reflect the scavenging effect of calcrete. High concentrations of Th, U, La, and Ce in depositional regime regolith probably reflect higher concentrations of resistate monazite and allanite.

Despite scattered mineral occurrences (Muhling and Brakel, 1985), no economic mineral deposits have been reported from the MOUNT EGERTON map sheet. Regolith chemistry combined with regolith mapping, and observations made at sample sites show that precious metals (Au ± Pd ± Pt) are occasionally found in regolith spatially associated with dolerite units. The possibility of stratabound sedimentary rock-hosted mineralization is indicated by relatively high concentrations of such elements as Pb, Zn, W, Ba, As, Bi, Ce, and Sb over parts of the Bangemall Supergroup away from areas of dolerite. Morris *et al*. (1998) suggested that dolerite-associated precious metal mineralization, and stratabound sulfide-associated mineralization are potential exploration targets in the area.

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