2. DYKE SWARM NORTHEAST OF BLUE TIER.

Two issues, in particular, were raised for review in this region. These were the characterisation of dolerite dykes and anomalies – and whether the magnetic responses are due to dolerite dykes; and the origin of the large but subtle underlying increase in field intensity which extends across the region from Blue Tier to the Gardens.

The nominal "dyke" effect dominates both image and contour presentations of the magnetic field (Figures 10 and 11) but only the image provides a clear indication of the underlying, but gentle, increase in the magnetic field toward the southern part of the sampled area.

The dykes:

Comparison of magnetic features with extant mapping leads to some interesting and immediate conclusions. While mapping (McClenaghan *et al*, 1983) is certainly and inevitably incomplete due to the realities of mapping (coverage, exposure, time spent), and those dykes which have been found are patchily exposed or discontinuous due to weathering or cover, there are many direct correlations between the magnetic field and some dolerite dykes. But, such correlations are not universal.

Many mapped dykes showing changes in strike (e.g., Sampsons Hill and Pretty Marsh Hill) are truly reflected and have magnetic continuations. There can be little doubt as to the origin of the magnetic responses in such cases and direct extrapolation is clearly justified.

Other dykes, especially in the area southwest of Sassafras Creek simply do not correlate with any anomaly and, even where some response is nearby, the required mapping error is too large to be an explanation. It may be concluded that many, if not most, dykes are not strongly magnetised and modelling even indicates that a few may have a reversed association indicating a reversed magnetisation. It is quite possible for induction and remanence effects to oppose and result in a material which appears virtually non magnetic. These variations might be explained by different aged members within the dyke swarm. Many of these associations can be noted in Figures 12 and 13.

It should also be noted that Cocker (1977) described two suites of dykes in the St Helens region. One, he inferred to be of Devonian (?) tholeiites, the other of possibly Cretaceous lamprophyric spessartites. Quite distinct magnetic properties could be expected and have been observed.

Some preliminary observations (Dr M McClenaghan, pers. comm.) based on site visits and sampling as a result of initial discussions and inspection of this data set may be summarized as follows. All values are of susceptibility.

Tertiary basalt.

The range of values from 79 observations at eight sites is 0.002 to 0.042 SI with a typical value of about 0.02 SI.

Dolerite (age unknown, Devonian inferred).

The range of observations from 68 observations at eight sites is 0.0005 to 0.025 SI with a representative value of the order of 0.015 SI.

Other fine-grained mafics (age unknown).
The range of 49 observations at seven sites is 0.0003 to 0.001 SI with a typical value of 0.0006 SI.
Gardens Granodiorite, by way of contrast, displays a range from 0.00004 to 0.0003 SI, typically 0.0002 SI.
These observations indicate the contrasts between mafic rocks in the region: they are distinctive.

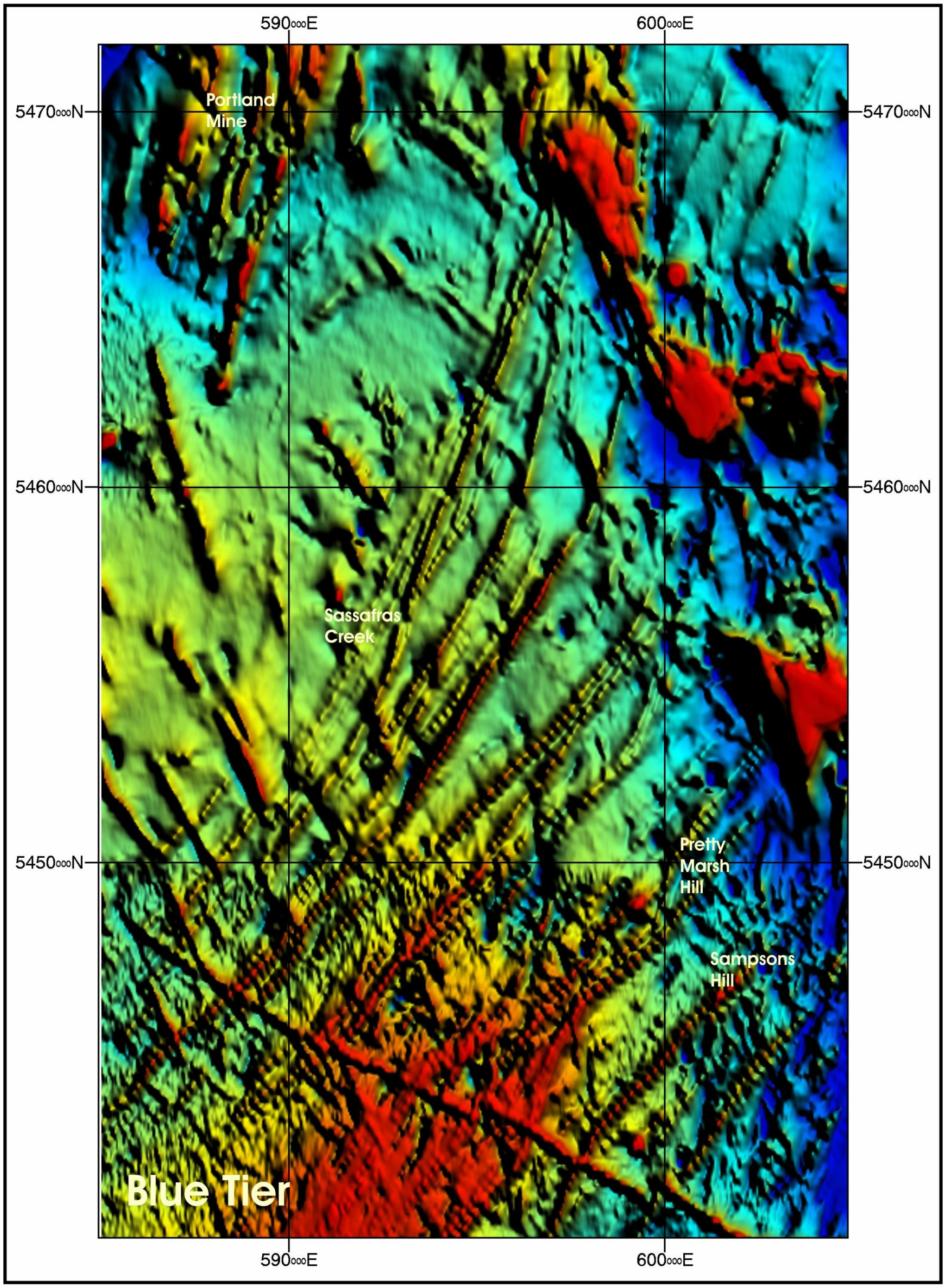


Figure 10: Image of Magnetic Field Intensity in the region northeast of Blue Tier.

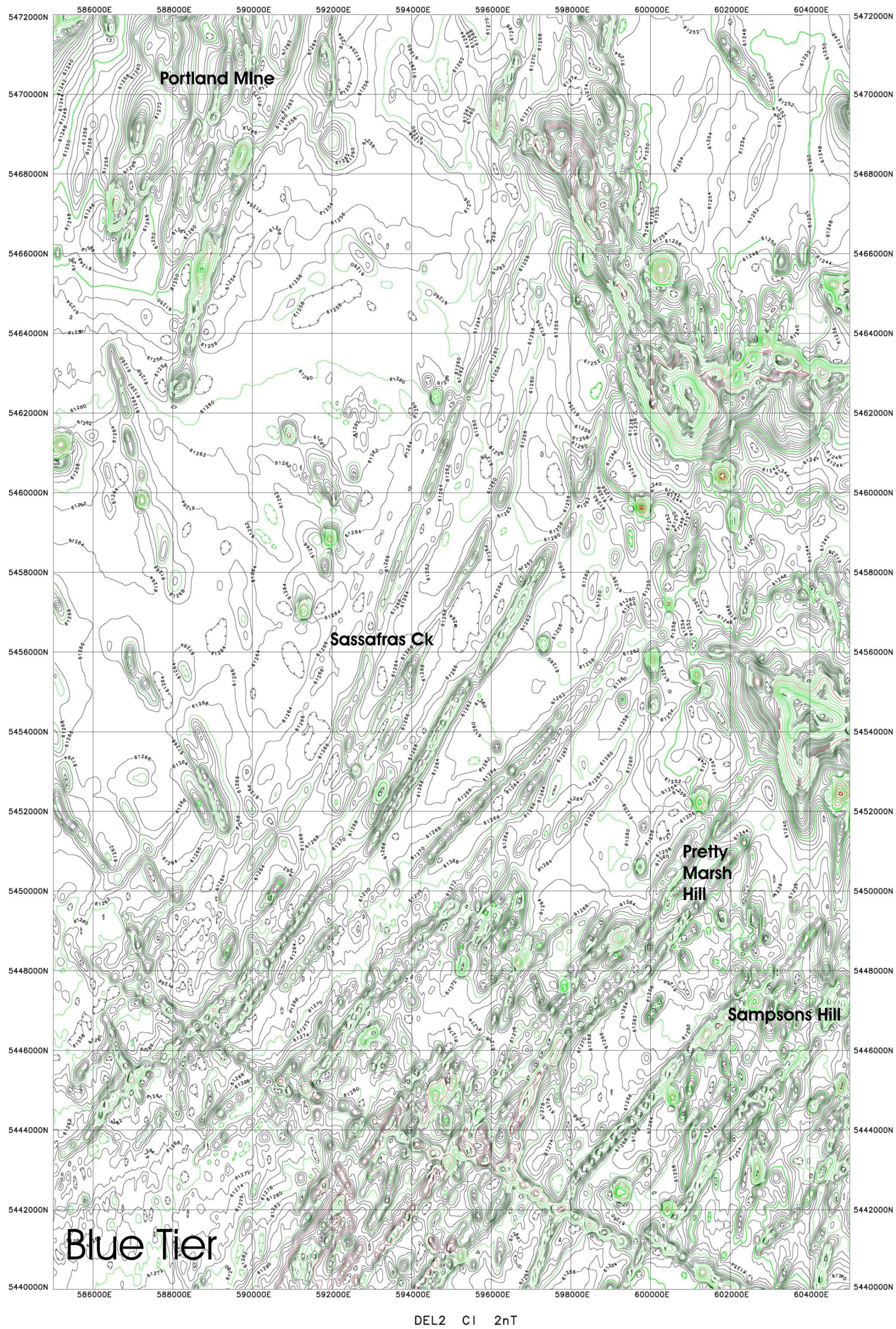


Figure 11. Contours of Magnetic Field Intensity in the region northeast of Blue Tier.

Virtually all dykes mapped, or inferred magnetically, in the Blue Tier region trend either northeast or NNE and many dykes show asymptotic changes to both trends. The trend rotates northward, to the north.

One of the most striking, and obvious, feature east of Blue Tier is that which trends approximately WNW-ESE from the south of The Gardens. This feature has all the characteristics of a dolerite dyke – yet no such material has yet been observed along its length. It dominates the southern part of the survey compilations (see Figures 10, 11 and 12).

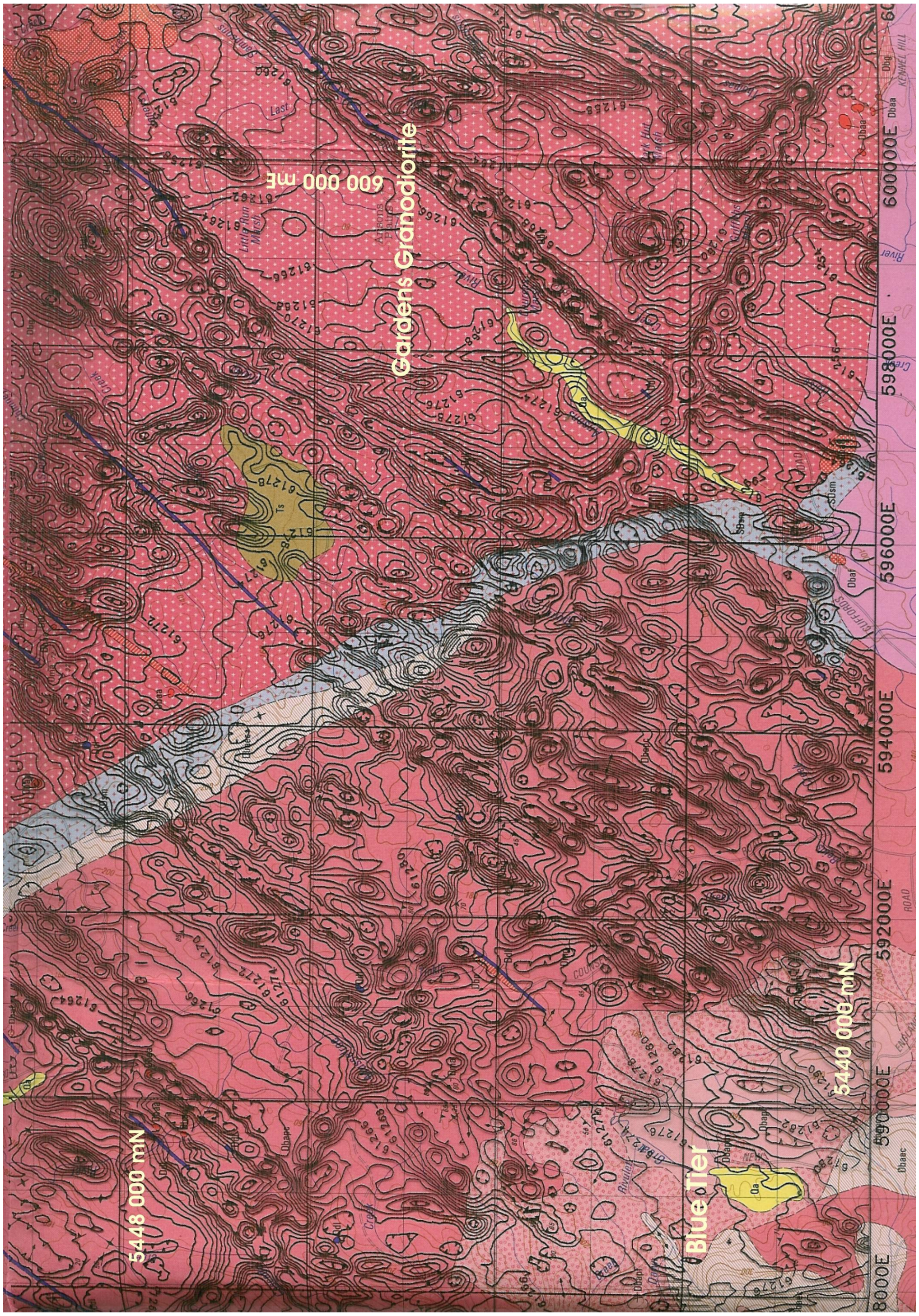


Figure 12. Detail of magnetic field and geological basemap (McClenaghan *et al*, 1983), NE of Blue Tier. Note the correlations between anomalies and mapped dykes – and the absence of such correlations in some cases.

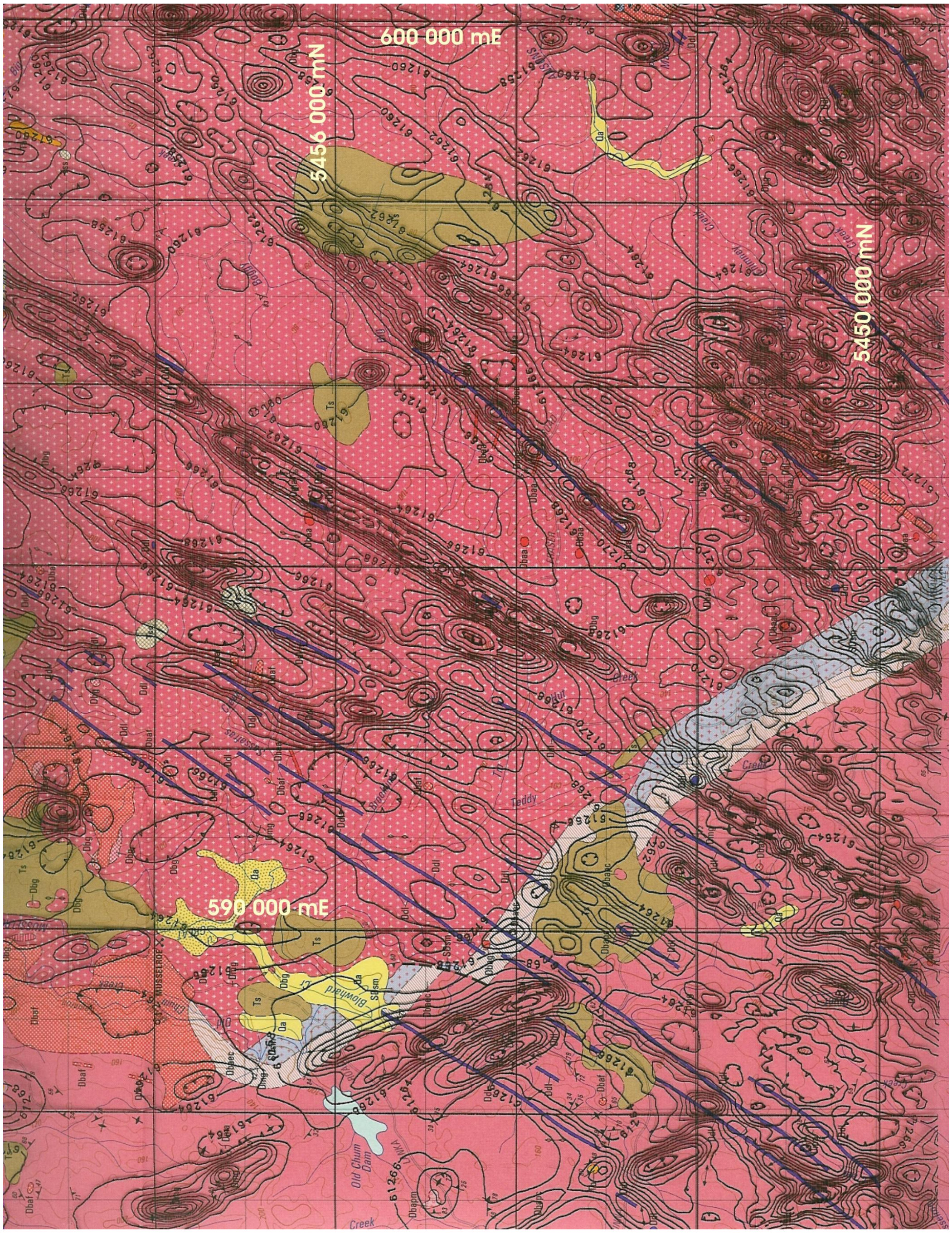


Figure 13. Detail of mapping north of Blue Tier showing the strong magnetic anomalies and the limited associations between them and mapped dykes. It is clear that many dykes are not magnetised and may be different ages.

Interpretation of dykes

Each of the possible variables – thickness, magnetic contrast, depth of weathering-burial-cover, dip and depth range – has been reviewed by modelling a large number of the observed anomalies. A sampling of models shown in the previous section (for Scamander) may be compared with the inferences made here.

Two variables have been shown to be either not critical or indeterminate: dip and depth range. The features extend several hundred metres in depth but no finer conclusion can be drawn until such time as several dykes have been located and the near surface variables (width and contrast) can be uniquely ascribed for that body. Similarly, all dips may be described as very steep to vertical.

Modelling has, of course, been restricted only to those dykes with a magnetic expression. Some of the others must be located and sampled and even surveyed with a ground magnetometer traverse.
Models are provided in Figures 14, 15 and 16.

Although the survey was flown with a terrain clearance of 70 to 100 m (normally 75 to 90 m) in this region, modelling suggests a general weathering or cover depth of between 10 and 50 m and that this weakens and breaks up the continuity of any magnetic response. This variation in depth to relatively fresh or recognisable rock may account for both the patchy surface expression and the magnetic character.

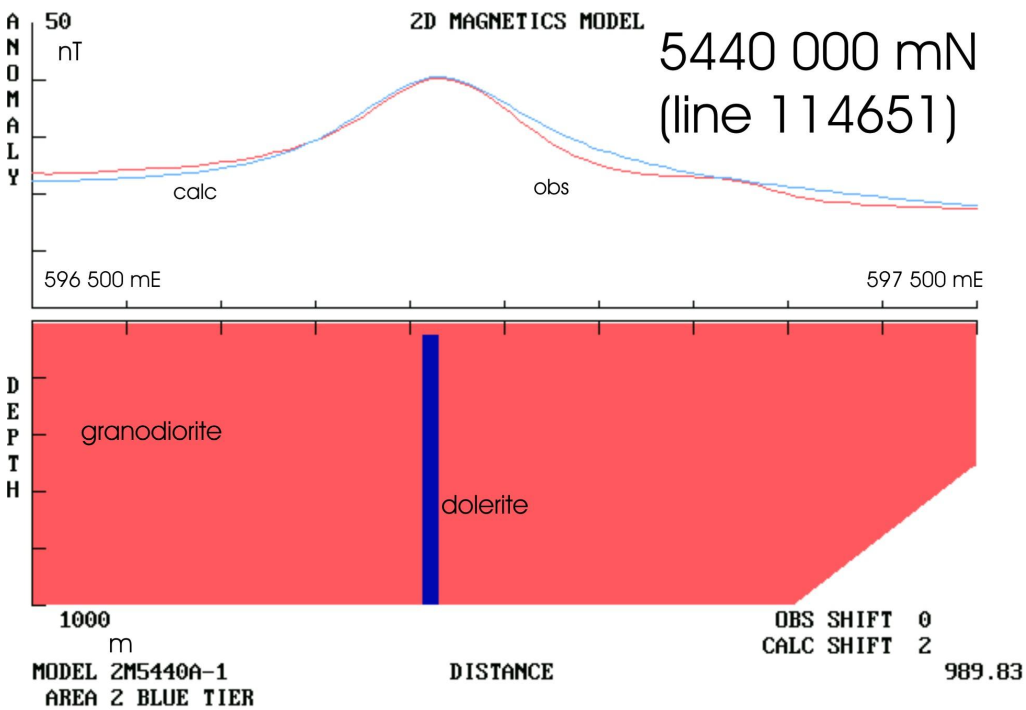
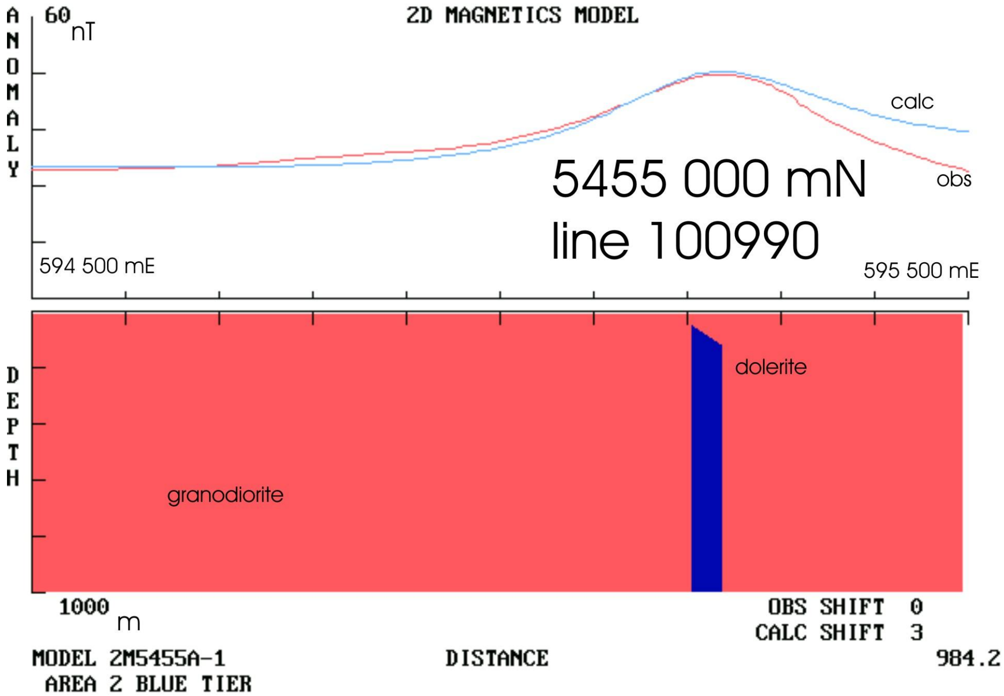


Figure 14. Magnetic model, 5440 000 mN. An adequate solution requires a dyke of 15 m thickness, dipping vertically, and a contrast of about 0.018 SI. The typical depth to magnetised (unweathered) rock is of the order of 50 m. (The corner cut-off of the granite marks the limit of the granitoid and its intrusion by another)



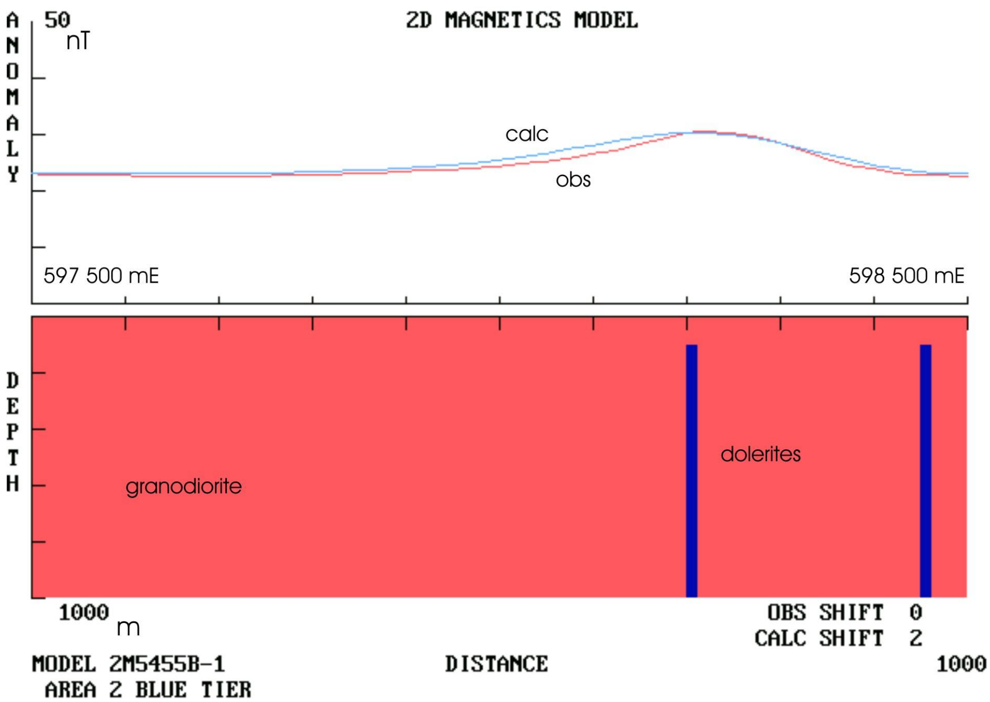


Figure 15. Examples of dykes of various thickness and contrasts which do not outcrop but which are along strike from segments which do.
Contrasts are variable: 0.013 SI (upper diagram) and 0.02 and -0.01 SI (lower diagram). The dykes in the lower diagram are 10 m thick.

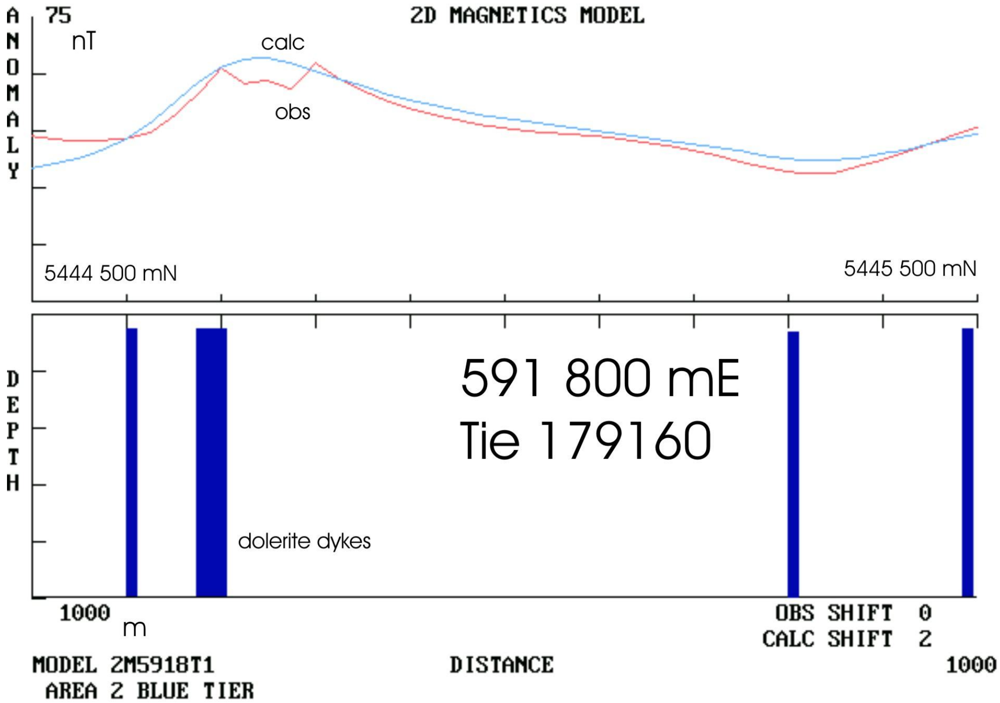


Figure 16. Dykes as seen in a N-S tie line. The thick body is the transverse structure seen in Figures 10, 11 and 12. Part of thickening effect, and broken response, is due to line orientation and is an apparent thickness (maximum 30 m). In this diagram two of the dykes are negatively magnetised (1 and 3 from left side) and contrasts and thicknesses from left are -0.007 SI, 10m; 0.015 SI, 30m; -0.007 SI, 10 m; 0.013 SI, 10 m.

The range of positive contrasts inferred from modelling of dykes is 0.001 to 0.026 SI when rated against a background of granodiorite or Mathinna Beds (max. 0.0026 SI). Those bodies with negative contrasts fall in the range -0.006 to -0.012 SI.

The transverse dyke (Figure 12) described above is anomalous in terms of the predominant magnetic grain (see Figure 10) but it is not anomalous in terms of linked disruptions and kinks in that grain. The western part of the region contains a number of features, some certainly dykes, which trend NW-SE. Most of these have limited strike length but the orientation can be recognised in isolated fragments across the entire area.

The pattern of deformation or disruption across this transverse dyke is most irregular (Figure 12). At 600 000 mE there is a dextral offset of another dyke and the transverse structure is offset sinistrally. At 598 000 mE both it, and another dyke, merely intersect with no perceptible offsets. At 596 500 mE another dyke remains continuous through its intersection but it is deformed sinistrally. At 595 000 mE there is a similar but less well defined or deformed relationship with a sinistral offset at the transverse structure. At 593 000 mE the intersection is simple but at 591 500 and 590 500 mE other dykes are terminated. At 589 000 and 588 000 mE other dykes show direct intersections but at 587 500 mE the transverse dyke splinters to yield a reduced extension and a stronger feature trending NW. No offsets are noted where non magnetic dykes intersect the main structure (as north of Blue Tier).

The significance of these variations is unknown, both in terms of age of dykes or any controlling structures or stress fields. It must be admitted that a complex stress field may have existed at time of intrusion since the now-exposed structures were once buried several kilometres and may have been at considerable depth at time of their intrusion: a time and depth which may have varied for groups of dykes.

The selvage of hornfelsed Mathinna Beds mapped between plutons (Figures 12 and 13) is recognisable magnetically as a subtly non magnetic axis trending northwest. Variations in the magnetic field are generally much wider than the mapped zone. Most magnetic dykes do not cross this zone, while all non magnetic dykes appear to. This relationship suggests that the magnetic dykes are intra plutonic and the others may be more recent – post at least one batholith stage (compare Cocker, 1977)
.
Many of these inferences must be confirmed by detailed field inspection.
Are there in fact many more exposures? Are the dolerites different – and in what way? Can they be dated? The sites of several intersections should be reviewed now that the location of these is accurately known. Ground magnetic surveys may offer the most reliable and low cost means of location and assessment.

The large regional anomaly

Line 5440 000 mN samples the crest of the large regional feature extending east of Blue Tier (Figures 10, 17). The intensity of the magnetic field shows a modest increase: the critical aspect is the widespread nature of the change.

Previous workers have suggested west-dipping reverse structures in this region (Keele *et al*, 1994). Comparable east-facing structures near the Tamar region involve ultramafics (see Leaman, 1992; Roach, 1994; Leaman & Webster, 2002). These are the only known materials in Tasmanian geology which possess the necessary properties able to generate long wavelength responses from sources at considerable depth. No material actually exposed in the region can account for the effect; none is widespread nor sufficiently magnetised. Local materials (granodiorite, dykes, some members of Mathinna Beds) produce the minor elements enhanced strongly in image format.

Figure 17 presents a possible solution.
The soling structures are multiple and the simplest solution is shown in the diagram. The selvage between plutons may mark the ghost of the extension of at least one of these structures and the age relationships between displacements on the thrusts, the timing of the plutons and the insertion of elements of the dyke swarm may be inferred and may be related.

Mathinna Beds texture east of Gladstone

Consideration of the magnetic character within the Mathinna Beds was requested in at least two regions (see also Cokers Ridge and Mt Paris), including the area east of Gladstone. The southern part of this zone occurs in the northwest corner of Figures 10

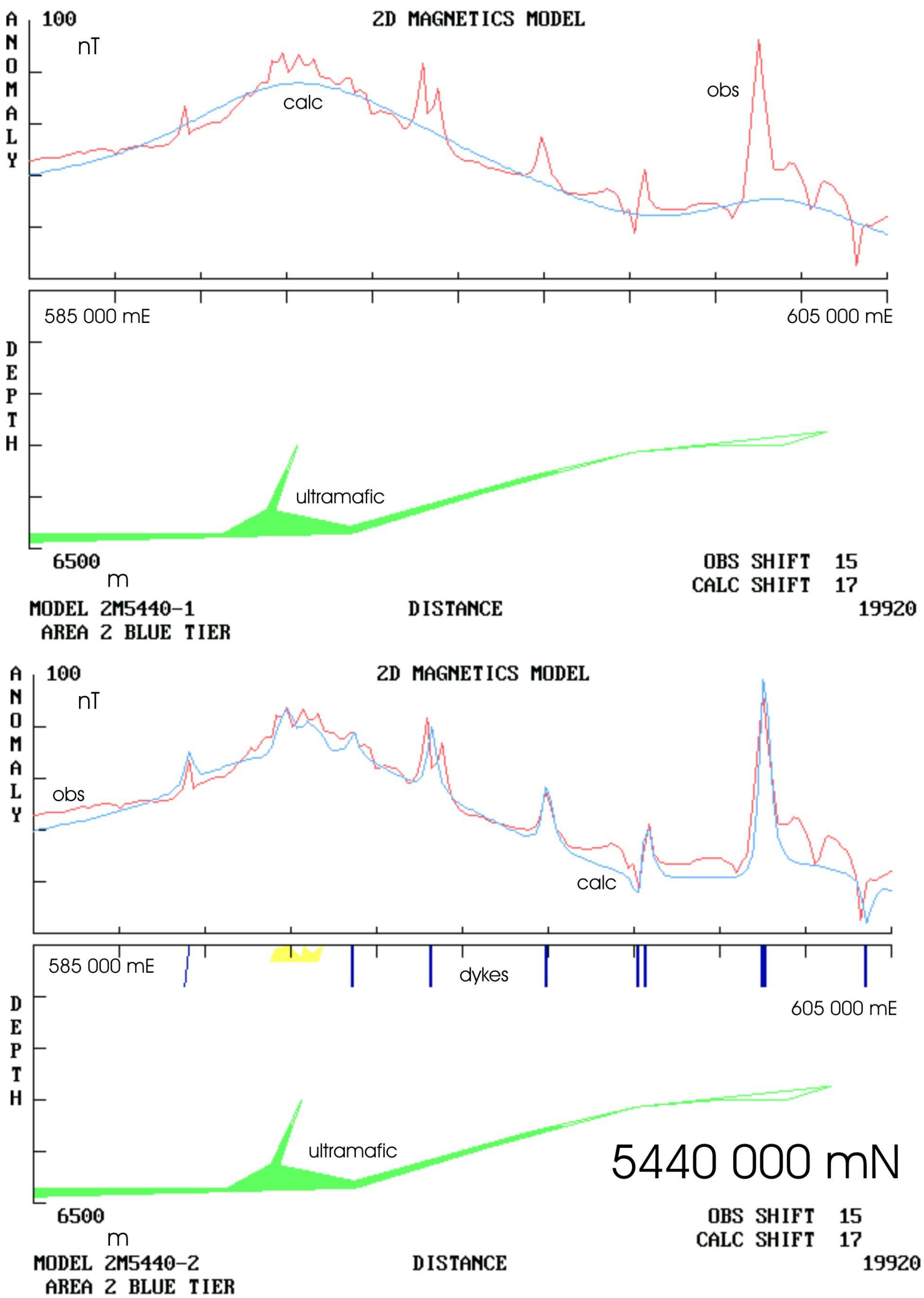


Figure 17. A possible solution for the regional anomaly in the region between Blue Tier and the coast. Local features insert noise into the profile but the entire feature is best explained by some combination of relatively shallow-dipping west facing structures which are marked with ultramafic slices.
Data line 114641.

and 11. These responses have been examined previously (e.g., Leaman, 1989, 1994b, 1994c) using data from a high resolution local aeromagnetic and ground survey. This older data, with closer line spacing and lower flight clearance, should be consulted since it is one of the few surveys of (probable) better coverage and resolution than the new survey. The model shown in Figure 18 is consistent with previous analyses and known properties.

These early surveys demonstrated that units within the Mathinna Beds are magnetised and may generate significant or apparently systematic anomaly patterns. The inferred properties were checked by sampling, mine site and drilling investigations. Those inferred properties were used in the model shown in Figure 18 and in other models in this assessment. The magnetic properties of the Mathinna Beds units rarely match the bulk contrast of the underlying granodiorite but are often about half the contrast of the intrusive (0.0006 to 0.0026 SI, v 0.0025 SI), and occasionally are more susceptible. These variations apply to the bodies in the model (left to right: 0.0012, 0.0019, 0.0014, 0.0026, 0.0005, 0.0025 SI).
This review of such variations within a regional context has not altered any conclusions offered in the exploration reports cited.

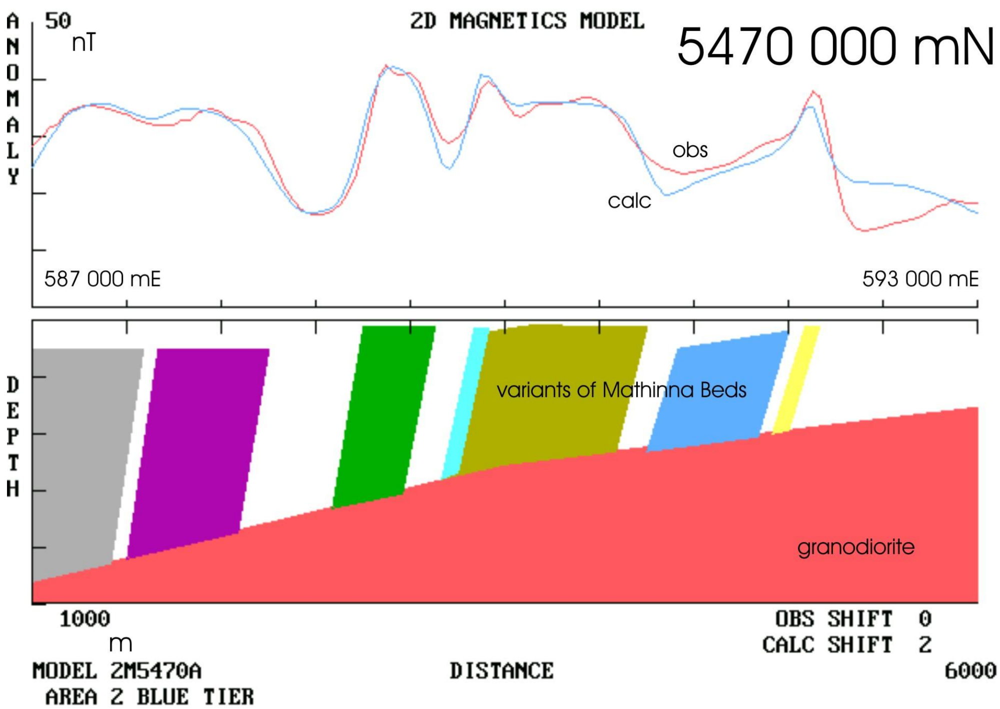


Figure 18. Modelled cross section of varied Mathinna Beds responses near the Portland Mine, east of Gladstone.
Data line 101730.