CHAPTER EIGHT: INTERPRETATION AND DISCUSSION

8.1 Introduction

The major objectives of this study have been to provide an interpretation of the upper crustal structure of the New England Fold Belt (NEFB) and attempt to further constrain the Palaeozoic evolution of the region by integrating results from potential field data with other available data. In the previous chapters, both gravity and magnetic models were constructed to match the observed gravity anomalies over the Tamworth Belt and the Gunnedah Basin, and magnetic anomalies along the Hunter-Mooki and Peel Faults. In particular, the main points of focus include the source and source geometry of the Meandarra Gravity Ridge within the Gunnedah Basin, the dip of the Hunter-Mooki Fault and the source of the magnetic anomaly associated with this thrust, and the dip and depth extension of the Peel Fault, rock magnetic properties of the serpentinite and the source of the Namoi Gravity High. It must be stressed that gravity and magnetic models are not unique and other models could also satisfy the data. The purpose of this chapter is to provide a structural interpretation of derived gravity and magnetic models.

8.2 Structural Interpretation and Discussion of Gravity and Magnetic Models

8.2.1 The Peel Fault

The orientation and vertical extent of the Peel Fault that separates the forearc succession of the Tamworth Belt and the accretionary wedge of the Tablelands Complex is a critical aspect of any reconstruction of the Palaeozoic tectonic evolution of the Southern New England Fold Belt. The subsurface geometry of the Peel Fault has been debated because previous geological and early geophysical works (e.g. Benson, 1913; Rod, 1974; Ramsay and Stanley, 1976) are very different from the more recent interpretation of the BMR91-G01 seismic data (Korsch et al., 1993a, b, 1997). Insights into the deep geometry of the Peel Fault are provided by the potential field models in this study. The magnetic anomaly associated with the Peel Fault is continuous throughout the study area. It is generally accepted that the anomaly is produced by the ultramafic rocks which occur (mostly serpentinised) along the Peel Fault (e.g. Ramsay and Stanley, 1976; Scheibner and Webster, 1982), and the ultramafic rocks have been used to infer the extent of the depth and the angle of dip of the Peel Fault. A rock magnetic study of the serpentinite samples collected in this study (Figure 5.1, 5.2 Table 5.1) indicates that the remanant contribution to the magnetic anomalies associated with the Peel Fault varies along the Belt. Both Attunga and Barraba serpentinite samples have a grouped remanence paralleling the present magnetic field, but the other localities do not. Magnetic modelling supports the presence of dyke-like tabular bodies possessing susceptibilities along the Peel Fault (Figure 8.1). The magnitude and shape of the calculated anomaly are very dependent on the thickness, dip, depth and susceptibility of the serpentinite body. Sensitivity analysis of the susceptibility of serpentinite prove that the observed anomalies of 2000 nT over the Peel Fault require a susceptibility of at least 4-5000 $\times 10^{-6}$ cgs (Figure 5.9), which is consistent with the measured susceptibility of serpentinite (but much higher than the value of 976 $\times 10^{-6}$ cgs reported by Ramsay and Stanley (1976)). Ground magnetic modelling indicates that the Peel Fault generally has a very steep eastward dip, although a very steep dip to the west is also possible at Glendhu and Manilla. The minimum depth extent of the serpentinite body is of the order 1-3km, but analysis of the depth extent of the serpentinite body indicates that a much larger extension of the depth to the base of the serpentinite body cannot be excluded by the magnetic modelling.

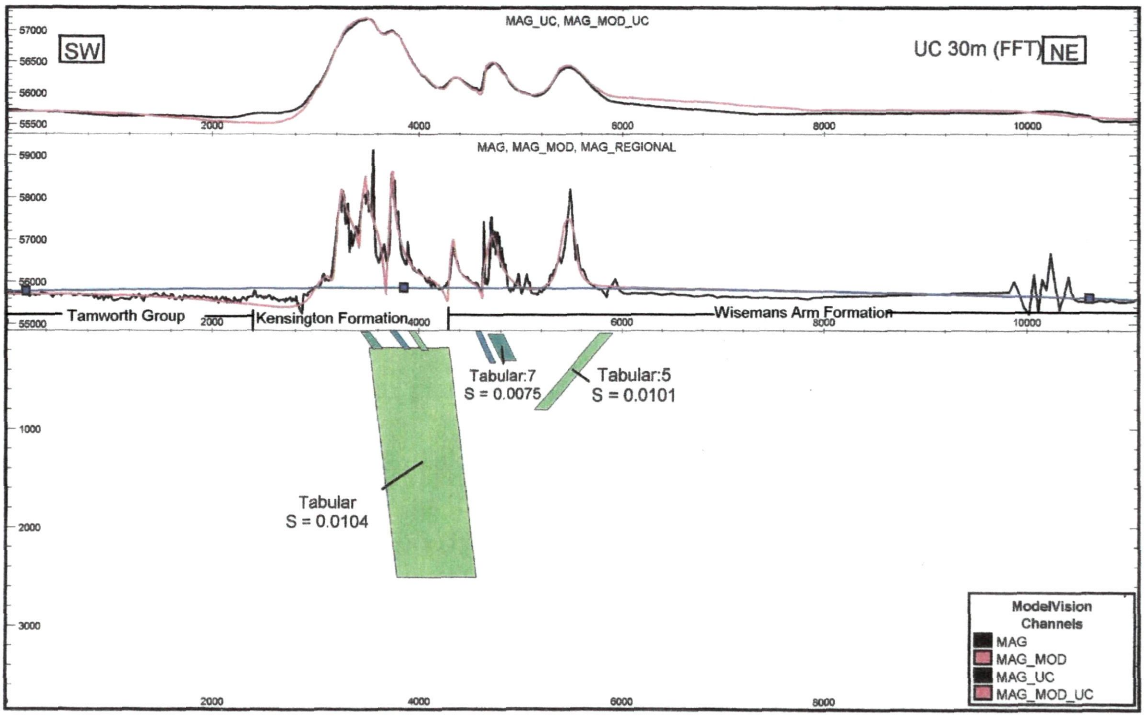

Figure 8.1 Modelled steep east-dipping serpentinite body emplaced along the Peel Fault, showing a good fit to the anomalies associated with the Peel Fault. For more detailed models refer to Figure 5.5e

The east-dipping Peel Fault as observed by the ground magnetic data was supported by the extensive modelling of the aeromagnetic data (Figure 5.8). A high-resolution aeromagnetic dataset along the Peel Fault enables the selection of numerous magnetic traverses that are exactly normal to the geological boundaries and have relatively simple anomalies suitable for magnetic inversion. These magnetic traverses provide a great opportunity to examine the subsurface geometry of the Peel Fault along strike. Modelling of the aeromagnetic traverses with an inversion solution shows that the serpentinite bodies along the Peel Fault mostly dip steeply to the east with a few exceptions, where the serpentinite bodies have an eastward dip of around 50° or less (Table 5.3). The east-dipping Peel Fault is also consistent with previous geological work (Benson, 1913, 1915; Crook, 1963; Scheibner and Glen, 1972) and geophysical work (Ramsay and Stanley, 1976; Woods, 1988; Edwards, 1996; Carter, 2002). The minimum depth extent of 1-3 km of the Peel Fault from the ground magnetic data of this study is approximately consistent with the minimum depth extent of the order of 500 m by Woods (1988) in the Bingara-Barraba area and the minimum depth extent of 1-2 km by Edwards (1996) in the Kootingal area, and 1.5-3 km by Carter (2002) in the Cobbadah area. These magnetic modelling studies also indicate that no constraint can be placed on the maximum depth extent to the base of the serpentinite body. The minimum depth extent is much less than the 5 km established by Ramsay and Stanley (1976), but their model was obtained using the mean susceptibility value of serpentinite (976×10^{-6}cgs) much lower than the measured value in this study. A body with lower susceptibility needs greater depth to explain the same peak than a shallow body with higher susceptibility does. An increased susceptibility incorporated with the remanent magnetisation data gives a good fit with a depth of 3 km or less.

While the magnetic study provides only a minimum depth estimate of 1-3 km to the base of the serpentinite, modelling of the new gravity data in this study (Chapter 7) suggests a much greater depth extent. Modelling of the new gravity profiles indicate that the Peel Fault has a steep eastward dip to depths of 15 km in all five profiles (Figure 8.2) (gravity lows to the east of the Peel Fault for the Manilla and Quirindi profiles are modelled as deep granitic plutons). The presence of granites is likely given the position of the Duncans Creek Trondjemite northeast of Nundle near the Quirindi Profile (e.g. Offenberg, 1967; Gilligan and Brownlow, 1987), and by a distinct half-circular gravity low on the regional gravity map near the Manilla profile. The subsurface structure inferred by Korsch et al. (1993a, 1997) that has the Peel Fault Great Serpentine Belt truncated at a very shallow depth by a westward dipping structure could not be modelled in the Tamworth, Barraba and Bingara gravity profiles. It seems clear that the Peel Fault dips to the east on a regional scale in the study area and must extend to depth of several km, although a depth of 1 km can be modelled for the Manilla and Quirindi profiles.

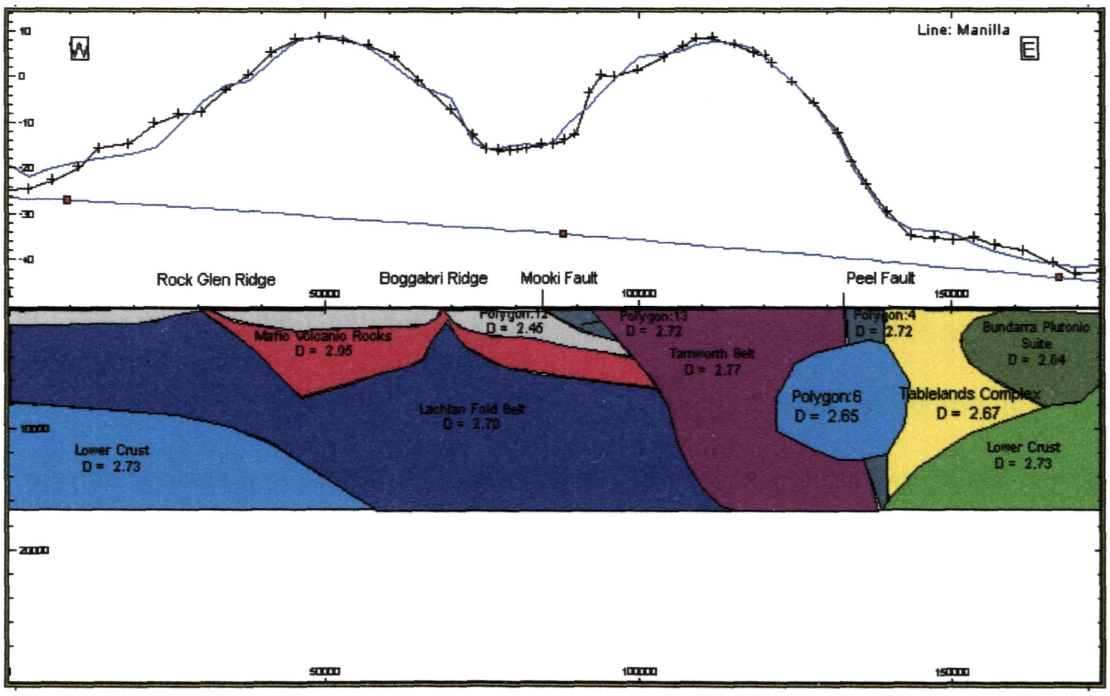

Figure 8.2 The Peel Fault was modelled on the Manilla gravity profile as an east-dipping fault with a depth extent of 15 km. The Meandarra Gravity Ridge was modelled as a dense mafic volcanic body. For more detailed models refer to Figure 7.9b.

8.2.2 The Tamworth Belt and the Hunter-Mooki Fault

The major "unknown" concerning the Mooki Fault is the origin of the magnetic anomalies along this fault. Geologically, the Mooki Fault forms the boundary between the Gunnedah Basin and the Tamworth Belt. There are several possible interpretations for the source of the magnetic anomalies associated with the Mooki Fault including: the plug-like correlative of the Warrigundi Igneous Complex in the south and a 20 km long dyke of hawaiite presumed to be genetically related to the Nandewar alkaline volcanic complex in the north (Ramsay and Stanley, 1976), the Early Permian Boggabri Volcanics in the Gunnedah Basin faulted against older rocks by the Mooki Thrust (Qureshi et al, 1990); and the contrast between higher magnetic susceptibilities of the Currabubula Formation and/or overlying Early Permian volcanic rocks to those of the Permian and Triassic sediments (Sydney-Gunnedah basin) to the west (Scheibner and Webster, 1982). The third interpretation has also been accepted by Schmidt (1994) and Greentree and Flood (1999). Susceptibility measurements in the field (Table 6.2) indicate that at least one Late Carboniferous conglomerate unit of the Currabubula Formation has a high susceptibility of around 2100×10^{-6} cgs, and this value may be less than the true susceptibility due to strong surface weathering of the measured samples. Magnetic modelling has shown that the anomalies associated with the Mooki Fault could be produced by an overturned western limb of a thrust propagation anticline or overturned bedding immediately east of the fault as inferred by Liang (1991) in the Keepit Dam area (Figure 8.3). Liang (1991) suggested that the thrust propagation fold has a thrust step-up angle of ~30 degree from the decollement as a fault-propagation fold. The magnetic modelling results were supported by the subsequent gravity modelling. A total of five gravity profiles were modelled, two of which (Tamworth and Bingara profiles) coincide with ground magnetic transverses (Figure 1.1), reducing the ambiguity in the data interpretation. The gravity modelling results generally showed that the Mooki Fault has a shallow eastward dip (Figure 8.3) and can be viewed as a splay fault of the Kelvin fault as suggested by Woodward (1995) in the Keepit Dam area. The subsurface geometry of the Mooki Fault derived from this study is in broad agreement with the geological observations in the west of the Werrie Basin by Carey (1934a, b) and at the Tulcumba Ridge by Liang (1991), who both suggested that the Mooki Fault represents a shallowly east-dipping decollement of a fault-propagation fold. The shallowly east-dipping Mooki Fault was also supported by previous magnetic and seismic surveys north of Gunnedah (Ramsay and Stanley, 1976; Korsch et al., 1993a, 1997), who both suggested that the Mooki Fault dips to the east at a shallow angle. Therefore it seems very clear that the Mooki Fault in the study area has a shallow eastward dip. What is less clear is what generates the strong magnetic anomalies along the structure. From this study it is clear that the magnetic anomalies immediately east of the Mooki Fault are produced by the contrast between high magnetic susceptibilities of the Currabubula Formation and/or overlying Early Permian volcanic rocks (Tamworth Belt) to those of the Permian and Triassic sediments (Sydney-Gunnedah basin) to the west.

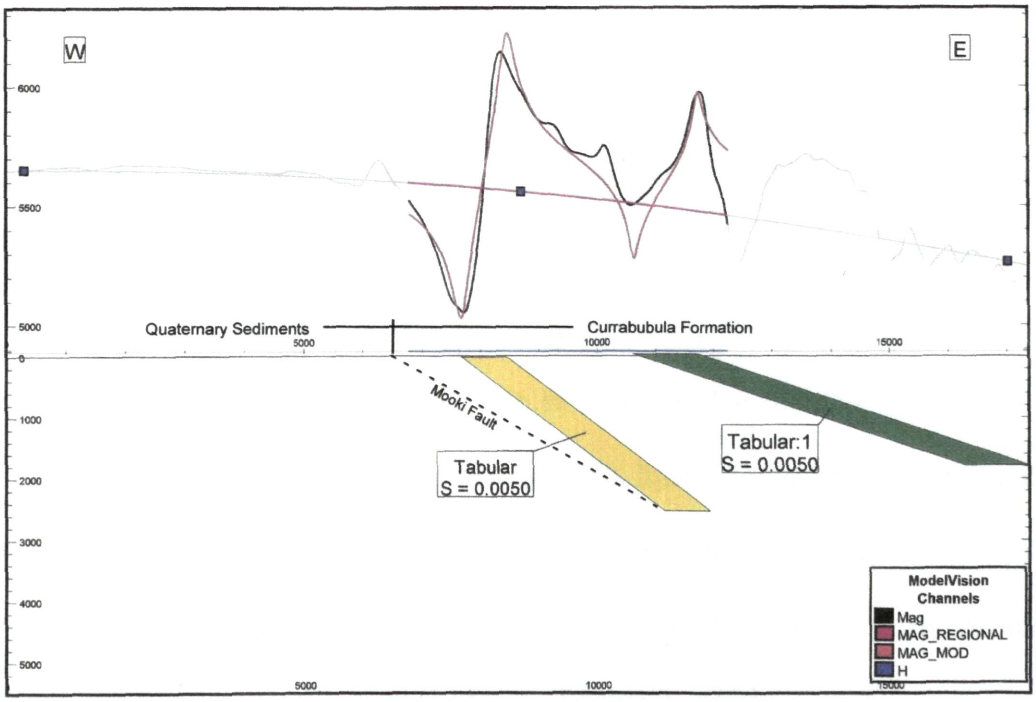

Figure 8.3 Overturned anticline magnetic model, showing a good fit to the anomalies immediate east of the Mooki Fault. For more detailed models refer to Figure 6.5b.

To the east of the Mooki Fault, the Tamworth Belt consisting of a succession of mainly volcaniclastic sedimentary rocks deposited in a forearc basin and volcanic rocks (e.g. Leitch, 1974; Korsch, 1977; Cawood, 1980), is bounded by the Mooki Fault to the west and the Peel Fault to the east. Because of the low magnetic response of the Belt, no attempt has been made to model the Tamworth Belt using this technique. The Tamworth Belt was modelled as a unit of 2.75-2.77 t m^{-3} density and width ranging from 49 km (Nundle Profile, Figure 7.5) to 59 km (Barraba Profile, Figure 7.7). The modelling results indicate that the Tamworth Belt is composed of rocks with average densities similar to the dense volcaniclastic rocks of the forearc basin. The measured densities of the Tamworth Group sedimentary rock (Table 7.1) are about the value needed to match the observed anomaly. This is supported by the previous geological work by Crook (1961a) in the Tamworth-Nundle area, Chappell (1968) in the Tamworth-Barraba district, and geophysical work by Glen et al (1993) in the Manilla area. The modelling results also indicate that the Tamworth Belt has a broadly similarity along the strike, reflecting a consistency on a regional scale.

It is generally accepted that the Tamworth Belt represents a forearc succession related to a westward subduction zone on the eastern margin of Gondwana during much of the Early Cambrian –Late Carboniferous (e.g. Leitch, 1974; Korsch, 1977; Cawood, 1982; Murray; 1997), although an eastward subduction was proposed for southern NEFB during the Devonian (Aitchison and Flood, 1995). The Belt was folded, uplifted and thrust westward over the Late Permian-Triassic Sydney Gunnedah Basin during the Hunter-Bowen event (Scheibner, 1999). The timing of folding of the Belt is constrained by a synchronous remagnetisation which shifted progressively from the southeast in the early Permian to the northwest in the mid to late Permian (Lackie and Schmidt, 1993).

A gravity high over a folded and thrust forearc succession is not unique to New England Fold Belt. The Great Valley sediments of California also show similar geophysical features (e.g. Ivanhoe, 1957). Both the New England area and California have a broad accretionary complex along the coast (Tablelands and Franciscan Complex), an interior region interpreted to be a former forearc basin (Tamworth Belt and Great Valley sediments) (Blake and Murchey, 1988a, b; Glen, 1990). Both forearc secessions correspond to gravity highs (Ivanhoe, 1957; Lonsdale, 1965; Godfrey et al., 1997). However, interpretations of the gravity highs are different. The gravity high over the Great Valley of California was interpreted to be produced by the ophiolite basement beneath the forearc secessions (e.g. Godfrey et al., 1997) rather than the high density forearc succession inferred to be the cause of the gravity high in this study.

8.2.3 The Gunnedah Basin

To the west of the Mooki Fault the Gunnedah Basin is part of the Sydney-Bowen foreland basin (Jones et al, 1984). Modelling results in this study indicate that the Gunnedah Basin could be modelled as an Early Permian rift basin largely filled with mafic volcanics, which have a high density (Figure 8.2). The volcanic rocks have a steep western margin and a gently dipping eastern margin. The eastern part of the Palaeozoic Lachlan Fold Belt forms the basement to the mafic volcanic rocks (Korsch et al, 1993a, b, 1997). The Early Permian volcanic rocks underlie the Late Permian and Triassic fill of the Gunnedah Basin. The thick succession of mafic volcanics below the early Permian sedimentary rocks of the Gunnedah Basin is supported by the existing petroleum and coal exploration wells that penetrate the top of the interlayered volcanic and sedimentary rocks (e.g. Leitch, 1993; Murray, 1994; Korsch et al., 1997; Krassay et al, in press) and by the BMR91-G01 seismic data that imaged a thick (3+ km), well layered succession (Korsch et al., 1993a, b, 1997). On the seismic section, the modelled volcanic body was interpreted to be related to the Boggabri Ridge composed of mainly high density mafic rocks (Korsch et al., 1993a, b, 1997; Krassayet et al, in press), which is part of the same volcanic belt as the Early Permian Werrie Basalt and Warrigundi Igneous Complex (Roberts and Engel, 1987; Flood et al., 1988; Krassay et al., in press).

The geometry of the mafic volcanic body modelled in this study is approximately consistent with the work by Qureshi (1984, 1989) and Krassay et al (in press). Krassay et al (in press), modelled the Meandarra Gravity Ridge using observed gravity profiles along seismic lines (BMR91-G01, BMR84-14) and gridded profiles, and concluded that the anomaly within the basin is produced by a dense mafic body related to rifting during formation of the basin. To the south of the Gunnedah Basin, Qureshi (1984) modelled the gravity anomaly within the Sydney Basin as a mafic volcanic body extending 12 km within the upper crust, the base of which has an easterly dip of 53° on the west side and westerly dip of 21°-33° on the east side (Figure 7.2). Qureshi (1989) modified his model by adding a tabular body within the lower crust to form a link to the mantle.

Gravity highs within the sedimentary basin is commonly related to extension or rift basins such as the American Midcontinent Rift (Hinze et al., 1990; 1992) and parts of the East Africa Rift System (Swain, 1992). These rift systems are similar to the Gunnedah Basin in that all areas reveal a gravity high within the sedimentary basin. A similar configuration is seen in the gravity model of the American Midcontinent Rift system (Hinze et al., 1990; 1992). Hinze et al. (1992) suggested that high density mafic volcanics within the graben produced most of the observed gravity anomalies on the basis of limited outcrops of mafic volcanic, and deeply-penetrating seismic reflection data obtained across the rift, comparable to what has been interpreted for the Gunnedah Basin.

8.2.4 The Tablelands Complex

The gravity anomaly shows a sharp decrease to the east of the Peel Fault and reaches a significant low over the Tablelands Complex. This is considered to reflect the transition from the higher density mafic volcaniclastic sedimentary rocks to the west to the lower density mud rocks to the east. The Tablelands Complex was modelled as a unit with a density of 2.67-2.69 tm^{-3} with low density granite intrusions at depth in all gravity profiles. The accretionary wedge has an average density of 2.67 tm^{-3} except for the Woolomin Association, which has a relative high density due to metabasalt and jasper components. The gravity model of the Tablelands Complex fits the structure inferred from a wide-angle reflection and refraction seismic study along north-south profile throughout the New England Batholith that suggested rocks of granitic composition make up a large part of the crust (Finlayson and Collins, 1993).

CHAPTER NINE: CONCLUSIONS

9.1 Conclusions

This study presented updated potential field modelling of the Tamworth Belt and its bounding faults, as well as the Gunnedah Basin, with emphasis on the subsurface geometry of the Mooki and Peel Faults, using new ground gravity and magnetic data, and rock physical property measurements. The conclusions generated from this study include the following:

1. The serpentinite along the Peel Fault has a high susceptibility, generally ranging from 2000 to 9000×10^{-6}cgs. The mean value of each locality is in the range 3000 to 5500 $\times10^{-6}$ cgs, which is approximately consistent with the measured susceptibility of $1000\text{-}4700\times10^{-6}$ cgs found by Edwards (1996), but is much higher than the 976 $\times10^{-6}$cgs reported by Ramsay and Stanley (1976). Sensitivity analysis of a tabular magnetic body reveals that a minimum susceptibility of 4000×10^{-6}cgs is needed to generate the observed high amplitude anomalies of around 2000 nT.

2. Mean Koenigsberger Ratio values for each serpentinite locality range from 0.5 to 0.9, although samples can be greater than unity. Some localities (Attunga and Barraba) have a strong VRM parallel to the present earth's field, and thus the remanence contributes to the overall magnetization, and has been included in modelling of the magnetic anomalies at these locations. The measured susceptibility and remanence values for each traverse are sufficient to explain the observed magnetic anomalies generated by the serpentinite in this study.

3. Modelling of ground magnetic data indicates that serpentinite bodies along the Peel fault are subvertical and most dip steeply to the east (80°-90°), but a shallower dip does occur at Tarakan. The minimum possible depth extent of the serpentinite bodies does vary along the strike length of the fault with the Tarakan profile being the least (~1km) and the Nundle profile being the greatest (~2.5km). When modelling of the magnetic transverses extracted from the aeromagnetic data is considered, the minimum depth extent to the base of the

serpentinite does vary from ~800 m to ~3.5km. Most of the modelled serpentinite bodies dip steeply to the east but a dip of about 50° was modelled at Upper Bingara, north of Woodsreef. Unfortunately, the magnetic models do not discriminate models with a greater depth extent and thus depths much greater ($\approx$10 km) can also produce a good fit to the data. When gravity modelling of the Peel Fault is considered, the fault can be extended much deeper in some localities.

4. Interpretation of aeromagnetic data indicates that in the region close to the Mooki Fault, magnetic high domains correspond to the Late Carboniferous Currabubula Formation, and that magnetic anomalies immediately east of the Mooki Fault are most likely due to the contrast between higher magnetic susceptibilities of the Late Carboniferous Currabubula Formation on the east side of the Mooki Fault and the Late Permian and Triassic sediments (Sydney-Gunnedah Basin) to the west.

5. Gravity modelling indicates that the Mooki Fault has a shallow dip to the east. Modelling of magnetic data indicates that the anomaly immediately east of the Mooki Fault can be modelled as the limbs of an overturned anticline and/or a dome related to a fault-propagation fold adjacent to the Mooki Fault at the west edge of the Tamworth Belt, which has a thrust step-up angle of ~30° from the décollement as documented by Liang (1991) at Tulcumba Ridge and by Carey (1934a, b) to the west of the Werrie Basin. Alternatively, the anomalies can be modelled as a dyke-like body emplaced along the Mooki Fault that dips at an angle of 25°, however the susceptibility that is required to achieve this is far too high when compared to published susceptibilities and susceptibilities measured in this survey and this model is not considered realistic. Modelling of the five gravity profiles show that the Mooki Fault has the Late Carboniferous and Early Permian rocks of the Tamworth Belt thrust over Permian rocks of the eastern margin of the Early Permian-Triassic Sydney-Gunnedah Basin for 15-30 km.

6. The Tamworth Belt has a relatively high density and produces a prominent gravity high. The measured density of hand samples shows that the Devonian dolerite immediately west of the Peel Fault has the highest density of 2.81-3.26 tm^{-3}, and the Devonian volcanic breccia and mudstone has a relatively high density of 2.68-2.83 tm^{-3} and 2.66-2.76 tm^{-3}, respectively. Both siltstone and mudstone of NRC drill cores of the Tamworth Group near Nundle have a relative high measured density of 2.70-2.80 tm^{-3} and 2.71-2.79 tm^{-3}. Gravity modelling of this study confirmed that the Tamworth Belt has a relatively homogeneous and high density (2.74-2.77 tm^{-3}) compared to the rocks of both the Tablelands Complex to the east and the Sydney-Gunnedah Basin and Lachlan Fold Belt rocks to the west and hence produces a prominent gravity high with few near surface anomalies. The Woolomin Association, the most western part of the accretionary wedge, also has a high density of 2.72-2.75 tm^{-3} immediately east of the Peel Fault and this also contributes to the Tamworth Belt gravity anomaly. The composition of the belt of chert/jasper, metabasalt, and metadolerite probably results in this high density.

7. The gravity anomaly over the Tamworth Belt (except for the Quirindi Profile) generally showed a broad high characterised by a gradual reduction on the west side and a sharp reduction on the east side. The amplitude and width of the anomaly do not relate to the width of the outcrop of the Tamworth Belt. All gravity profiles could be modelled to get a good fit for the observed gravity anomalies using either the configuration of Korsch et al. (1997), that has the Tablelands Complex extend westward under the Tamworth Belt, or the configuration of Bramall and Qureshi (1984) who has the Tablelands Complex thrust over the Tamworth Belt. Modelling of the Manilla and Quirindi Profiles indicate that the Peel Fault could be either modelled as an east-dipping fault with a cut off at a depth of around 1 km by a westward underthrust Tablelands complex, or modelled as an east-dipping fault to a depth of 15 km with an introduction of a low-density unit (granite) beneath the Tamworth Belt.

Modelling of the rest of the gravity profiles (Tamworth, Barraba, and Bingara) indicates that the Peel Fault could be either modelled as an east-dipping fault to a depth of 15 km or modelled as an east-dipping fault truncated by a westward underthrust Tablelands Complex at a depth of around 7 km. Modelling results from this study do not fully support the previous seismic model by Korsch et al (1993a, 1997) on a broad regional scale.

8. Two suspected (blind) granitoids beneath the Tamworth Belt were inferred from the Gravity models at Nundle and east of Manilla, respectively. The granitoids are inferred to be emplaced during the Late Carboniferous to earliest Permian extension event (Korsch, 1982; Leitch, 1988; Allan and Leitch, 1990) or the Late Permian (Flood and Shaw, 1977, 1980; Shaw and Flood, 1981). The Duncans Creek Trondhjemite just northeast of Nundle (Offenberg, 1967; Gilligan and Brownlow, 1987) and/or the Mt Ephraim Granodiorite just south of Nundle (Gilligan and Brownlow, 1987; Ashley and Hartshorn, 1988) may be genetically related to the buried granitoids for the Quirindi profile. A half-circle gravity low in the regional Bouguer gravity map supports the existence of the inferred granitoids east of Manilla (Figure 7.4).

9. The Meandarra Gravity Ridge is produced by high density mafic volcanics. Modelling of the gravity data indicated that the high density mafic volcanics have a rift geometry with steep western margin and a gently dipping eastern margin with a maximum thickness of 4.5-6 km. The thickness of the mafic volcanics is thinner than the 12 km proposed by Qureshi (1984) in the Sydney Basin and the 4.5-9 km reported by Krassay et al (in press) in the Gunnedah Basin, and is much closer to the 3 km imaged by Korsch et al. (1993a, b, 1997) north of Gunnedah. The eastern part of the Palaeozoic Lachlan Fold Belt forms the basement of the mafic body. The Early Permian volcanics rocks and Lachlan Fold Belt units together form the basement of the Permian and Triassic fill of the Gunnedah Basin.

10. This study confirms that the serpentinite bodies along the Peel Fault are sub-vertical (most dipping steeply to the east). They extend at least several kilometres beneath the surface and may extend much further. This geometry is consistent with either a model involving the serpentinite being "scraped" off from a subduction plate or a model involving the serpentinite vertically uprising from serpentinised mantle wedge above the subduction plate.

11. This study portrayed, with gravity and magnetic modelling, subsurface geometries of the major structural boundaries across the Southern New England Fold Belt and the Gunnedah Basin and provided information that will better constrain geodynamic models of the New England Fold Belt. The use of the new integrated gravity and magnetic data sets has resolved some ambiguities and forced some reinterpretation of the Mooki and Peel faults. The method of laterally extending the interpretation along the strike as employed in this study has proven to be a useful technique for maximizing the value of the available information. The geometries inferred from this study reflect only the present configuration of the tectonic evolution of the study area. They are consistent with that the New England Fold Belt was a westward convergent plate margin at the east edge of the Gondwana Continent during much of the Palaeozoic and Mesozoic, and the Gunnedah Bain is a extension basin and formed during the Early Permian with a rift origin. The exact tectonic evolution remains in question and requires further geological and geochemical research because the intermediate geometries could not be inferred from the geophysical data.

9.2 Suggestions for Further Study

1. Because the uncertainties involved in the construction of the gravity models with the introduction of low density granitoids, it is suggested that a systematic study involving more detailed gravity acquisition as well as geological mapping in the Nundle area and to the east of Manilla is needed.

2. Because of the uncertainties involved with density estimates for the gravity modelling, a velocity-density model of the BMR91-G01 seismic data and chemical composition estimate of the crust of the study area would be useful in validating the results of this study.

3. A follow up investigation on detailed geochemical features of the Great Serpentinite Belt would be useful for understanding the emplacement of the Great Serpentinite Belt.