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KANMANTOO TROUGH

MINERALISATION STUDIES

SAEI CONSULTANCY REPORT

Submitted by

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1994

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A MODEL FOR STRATIFORM MINERALISATION IN THE TALISKER CALC-SILTSTONE OF THE CAMBRIAN KANMANTOO GROUP

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SUMMARY:

This study has identified and focussed exploration on syn-diagenetic mineralisation in the Talisker Calc-siltstone. The sandstone-hosted stratiform mineralisation is dominantly lead-zinc in nature and occurs within incised valley fills. A model for mineralisation is based on a genetic or sequence stratigraphic framework. Further work is recommended and includes detailed mapping and geochemical investigation of principal localities at Mount Torrens, Red Creek and the Karinya Syncline.

INTRODUCTION:

As part of the South Australian Exploration Initiative, geological investigation of the Kanmantoo Trough was undertaken in the first half of 1994 in which a number of key outcrop localities were considered important to the understanding of the stratigraphy and style of mineralisation in the Kanmantoo Trough. These included the Talisker and Brukunga Mines, Mount Barker Creek, the Mount Torrens Prospect and the Karinya Syncline. Subsidiary sections included Callington, Carrickalinga Head, King Point, Parsons Head, Red Creek, Sedan Hill, Truro Gorge and Tunkallilla Beach. Investigation at some of these localities is still in progress.

This study has interpreted the Talisker Calc-siltstone of the Cambrian Kanmantoo Group in terms of sequence stratigraphy and subsequently identified an unconformity-bounded depositional sequence which is host to several base metal sulphide deposits. Furthermore, it is the first documented example in the Adelaide Geosyncline whereby sequence stratigraphy has been used to explain the association of mineralisation with the development of a major unconformity or sequence boundary. The concepts of sequence stratigraphy have provided a means for chronostratigraphic correlation of outcrop data, resulting in more accurate surfaces for mapping and correlation, and higher-resolution stratigraphy for definition of new target areas. Consequently, attention has focused on the potential for mineralisation with other sequence boundaries in the Adelaide Geosyncline.

SEQUENCE STRATIGRAPHY OF THE TALISKER CALC-SILTSTONE

Early to Middle Cambrian sedimentation in the Kanmantoo Trough represents a renewed phase of rifting in the southeastern part of the Adelaide Geosyncline. The Kanmantoo Trough was a deeply subsiding fault-controlled basin where storm-dominated sedimentation rarely reached fairweather wave base. Abundant supply of siliciclastic sediments, combined with sufficient accommodation as a result of extensional tectonics, resulted in deposition of a very thick sediment pile that is referred to as the Kanmantoo Group. It unconformably overlies the dominantly platform carbonate succession of the basal Cambrian Normanville Group.

The Kanmantoo Group can be subdivided into four depositional sequences or Subgroups (Table 1). The unconformity-bounded depositional sequence represented by the Silverton Subgroup is a major transgressive-regressive cycle and comprised the Tapanappa Formation and basal Talisker Calc-siltstone. The base of the Talisker Calc-siltstone is defined as a sequence boundary at or near the top of the Backstairs Passage Formation. Above this unconformity, a channelised unit consisting of siltstone and fine-grained sandstone, often pyritic, grades upward into carbonaceous and calcareous shale. Grey siltstone and sandstone of variable thickness at the base of the Talisker Calc-siltstone is referred to as the Cooalinga Sandstone Member. It was deposited in a storm-dominated environment. Pebbly sandstone at the base of the Cooalinga Sandstone Member and its lateral equivalent in the Karinya Syncline, referred to as the Malabena Sandstone Member, is fluvial in origin. It unconformably overlies the tidally-influenced sandstones of the Backstairs Passage Formation. The Nairne Pyrite Member consists of pyritic siltstone and sandstone and was deposited in a shallow marine to estuarine environment. It is best developed in the central part of the Kanmantoo Trough where it is the major sandstone unit of the Talisker Calc-siltstone.

The Cooalinga Sandstone and Nairne Pyrite Members of the Talisker Calc-siltstone are contained within what is interpreted to be an incised valley fill (Fig. 1). The Talisker Calc-siltstone is overall transgressive and in turn grades upward into interbedded siltstone and sandstone of the Tapanappa Formation. The Tapanappa Formation was deposited during a regressive cycle of sedimentation. An unconformity at the base of the overlying Tunkallilla Formation (Table 1) caps the Silverton Subgroup.

MINERALISATION

It is significant that sandstone units at the base or within the interpreted valley-fill succession of the Talisker Calc-siltstone (Fig. 1) are host to mineralisation. The mineralisation is classified as sediment-hosted stratiform. It is often sub-economic due to low volume and is dominated by lead and zinc deposits. Lateral chemical zoning appears to be present. To the north, zinc is dominant in the Karinya Syncline; lead is the major base metal at Talisker in the southern part of the Trough; and both lead and zinc are important in the central region near Mount Torrens where typical grades of 6.6% Pb, 4.1% Zn and 23g/t Ag were obtained.

Two styles of mineralisation, syngenetic and epigenetic, are found within the Talisker Calc-siltstone. Syngenetic or early diagenetic mineralisation of possible exhalative origin appears to be associated with palaeo-aquifers, and may be related to groundwater movement of local extent. A classic example of this style is found in the Karinya Syncline and at Mount Torrens. Previous studies have suggested that biogenic reduction of sea water resulted in precipitation of base metal sulphides in the Nairne Pyrite Member. Such deposits form from fluids that have become acidified by pyrite oxidation or decomposition of organic matter. Metal transport may have been accomplished by chloride complexes. Pyrite in the Talisker Calc-siltstone may have formed by bacterial sulphate reduction in a low temperature environment, or at a higher temperature (e.g. >80°C) by chemical reduction related to biogenic methane generation. This is in contrast to some of the sulphide deposits of the overlying

Tapanappa Formation where sulphur isotope data suggested a hydrothermal source for the late-epigenetic style of mineralisation. A similar style of mineralisation in the Talisker Calc-siltstone is found at the Talisker Mine, where metal-rich fluids of hydrothermal origin were focused by structural features or shear zones during the Delamerian Orogeny.

CONCLUSIONS

A revised stratigraphic scheme for the Kanmantoo Group, based on sequence analysis, reflects the genetic relationship between constituent formations (Table 1). It has led to the recognition of an unconformity-bounded depositional sequence referred to as the Silverton Subgroup that is host to base metal mineralisation. Incised valley fills within the basal Talisker Calc-siltstone contain stratiform lead-zinc deposits. Mineralisation is associated with unconformities or flooding surfaces that are contained within the incised valleys. Exploration for base metal mineralisation in the Talisker Calc-siltstone should focus on the recognition of incised valleys at this stratigraphic level within the Kanmantoo Trough.

RECENT DEVELOPMENTS

Most of the work to date has concentrated on formulating a genetic stratigraphic framework for the Kanmantoo Group and identifying the stratigraphy of the various base metal deposits in the Silverton Subgroup. Based primarily on exploration by Aberfoyle Ltd, deposit characteristics have suggested an exhalative origin in a distal volcanic setting, despite restricted occurrence of volcanics at this level. However, recent field work has identified a 200 m thick column of volcanics in the Red Creek area, southeast of the Karinya Syncline. The volcanics are overlain by an unconformity-bounded depositional sequence, previously unrecognised that is capped by the Milendella Limestone. The occurrence of volcanics adjacent to the Karinya Syncline is very significant for it offers the best evidence to date of an exhalative source. It is classified as a third-order basin where mineralisation had not been identified prior to current investigation of the Kanmantoo Group. A prominent base metal anomaly (Zn 0.6%, Pb 0.1%) in a palaeochannel, overlying a regional unconformity, supports a syndiagenetic origin for the mineralisation. Aeromagnetic data suggest prominent structural trends that possibly provided pathways for fluid migration. The Karinya Syncline displays characteristics that tempt comparison with lead-zinc deposits at Century, Dugald River and Lady Loretta in the Mount Isa block.

RECOMMENDATIONS FOR FURTHER WORK

This study has suggested a syngenetic-early origin for sandstone-hosted mineralisation in the Talisker Calc-siltstone. Consequently, it has focussed exploration attention on this genetic unit in the Kanmantoo Trough. Results of this study further suggest that the Mount Torrens-Red Creek-Karinya Syncline transect offers the best opportunity to further develop an exploration model for mineralisation in the Talisker Calc-siltstone for two reasons. Firstly, fair to good outcrop is associated with two components, namely structure and volcanics, that are considered vital to formation of significant base metal deposits in this unit. Secondly, minimal exploration has been undertaken in these areas. CRA investigated Mount Torrens in the mid-70's and more recently, has carried out a limited geophysical programme in the Karinya Syncline.

It is recommended that detailed mapping be carried out at Red Creek, Mount Torrens and the Karinya Syncline to test the validity of the current model for syn-diagenetic mineralisation in the Talisker Calc-siltstone. It will require a comprehensive suite of petrographic and geochemical analyses. The programme does not aim to discover an economic deposits in these areas, but to develop a model that can be applied elsewhere.

Report dated

November 1994

	Forbes (1957)	Thomson & Horwitz (1962) Thomson (1969a, 1969b)		Daily & Milnes (1972,1973)		Dyson, Gatehouse & Jago (this note)	
KANMANTOO GROUP	Brown Hill Beds	Brukunga Formation	Brown Hill Greywacke Member	Wattaberri Subgroup	Middleton Sandstone	Not Yet Investigated	
					Petrel Cove Formation		
			Tungkillo Marble Member	Brown Hill Subgroup	Balquhidder Fmn		
			Nairne Pyrite Member		Tunkalilla Formation		
	Inman Hill Formation	Inman Hill Formation		Inman Hill Subgroup	Tapanappa Formation	Silverton Subgroup	Tapanappa Formation
					Talisker Calc-Siltstone		Nairne Pyrite Member Talisker Calc-Siltstone Cooalinga Sltstone Mbr
					Backstairs Passage Formation	Keynes Subgroup	Backstairs Passage Formation
	Strangway Hill Formation	Strangway Hill Formation			Carrickalinga Head Formation		Carrickalinga Head Formation
					Campana Ck Sltstone Mbr		Campana Ck S/stone Mbr
		Milendella Limestone Member			Blowhole Ck Sltstone Mbr		Milendella Lst; Blowhole Ck Sltstone Mbr
					Madigan Inlet Mbr		Madigan Inlet Mbr

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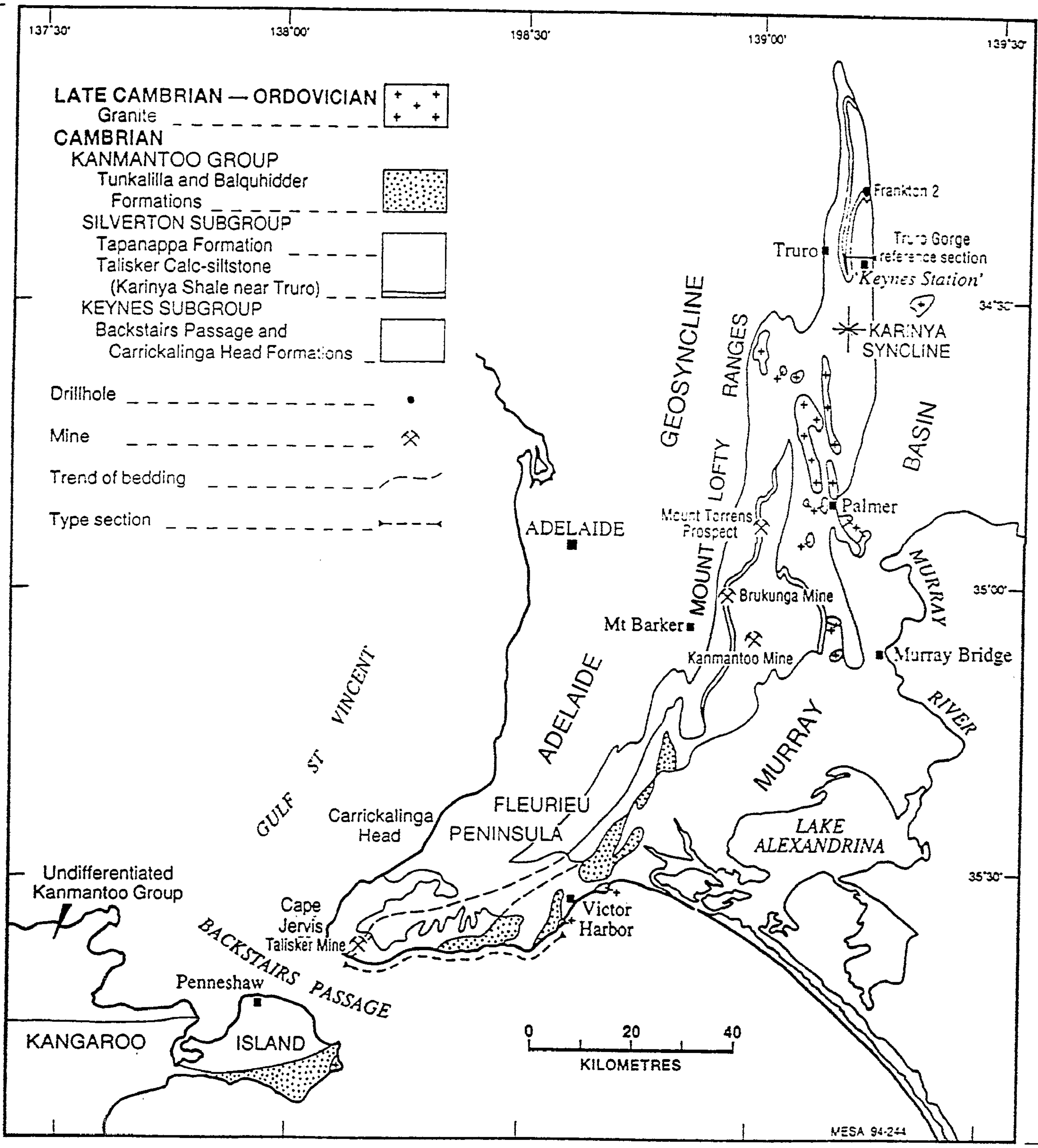

QGN 127
Author: Ian Dyson.
Figure 1: Geology of the Kanmantoo Trough

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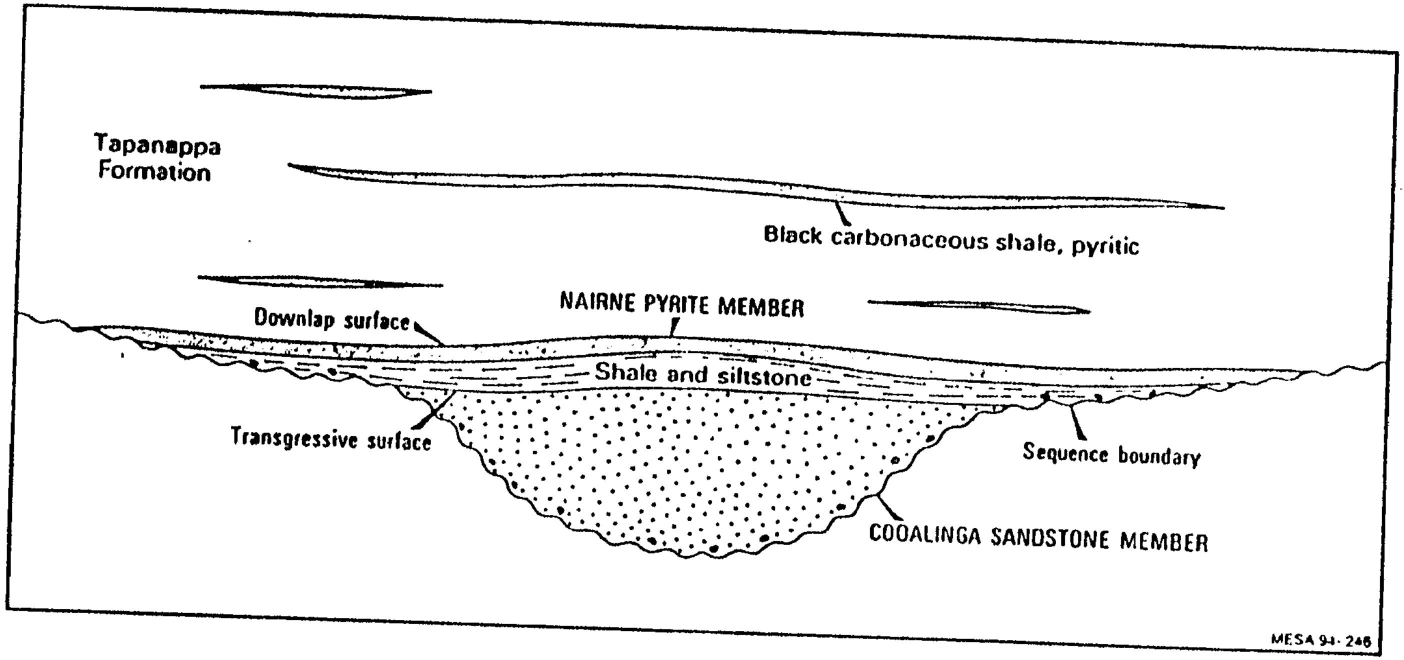

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FIG. 3, SCHEMATIC DIAGRAM OF AN INCISED VALLEY FILL OF THE TALISKER CALC-SILTSTONE, ILLUSTRATING THE MAJOR BOUNDARIES WITHIN A SEQUENCE STRATIGRAPHIC FRAMEWORK

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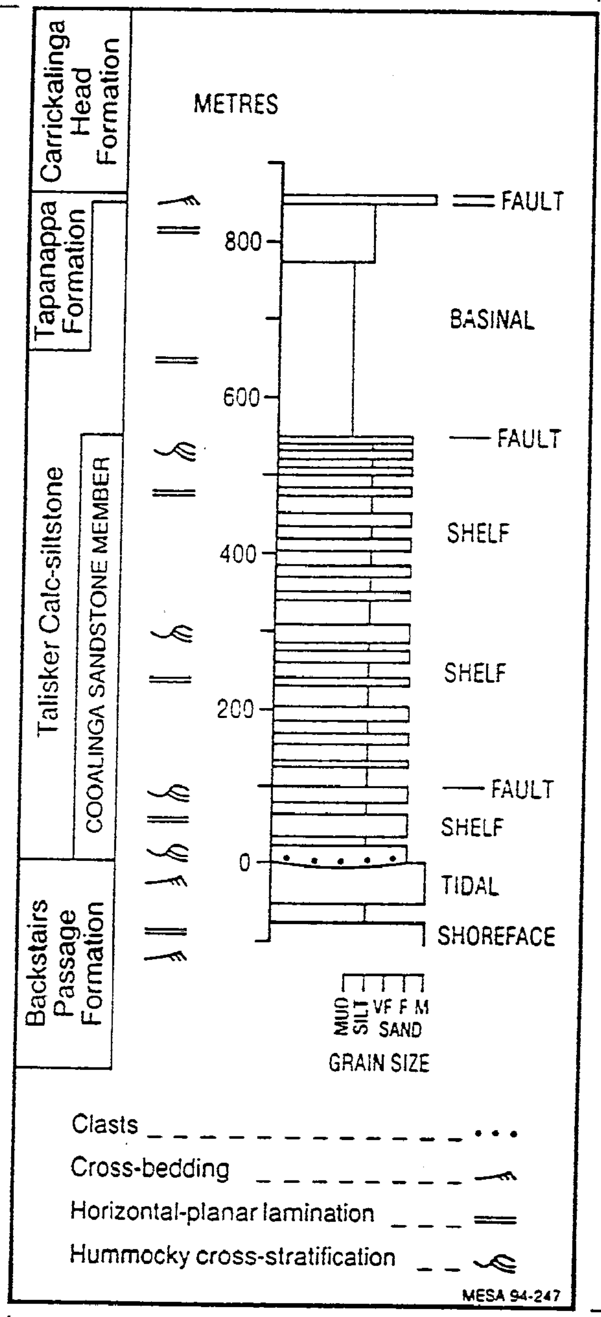

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Figure 4: Stratigraphic log of the Cooalinga Sandstone Member

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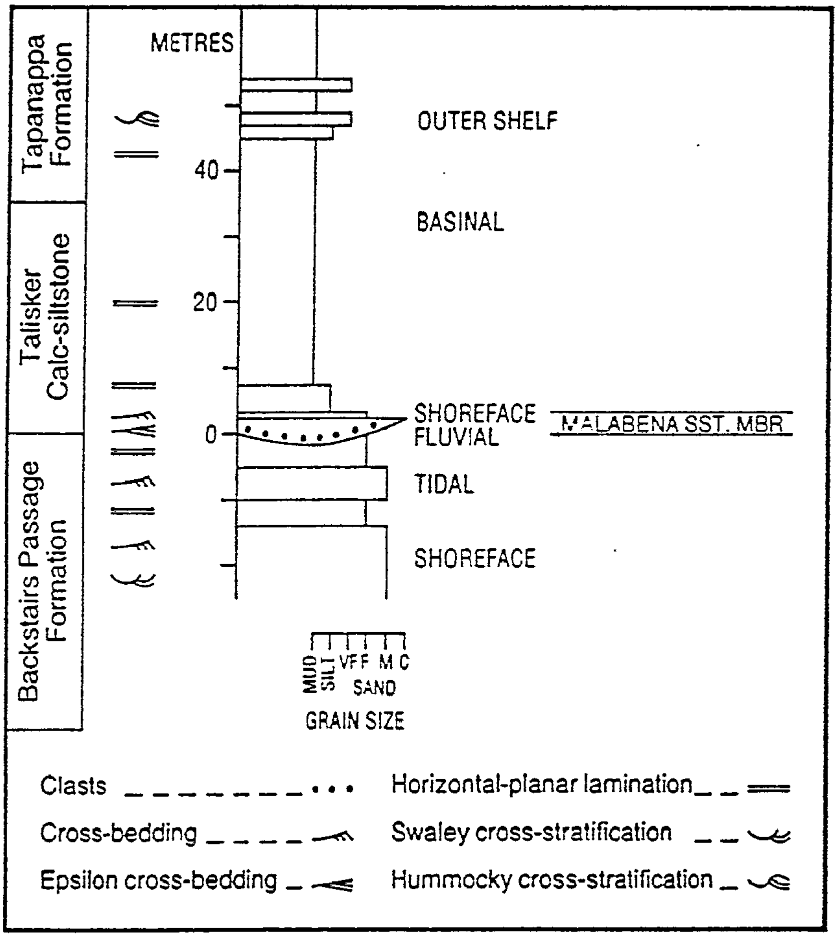

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Figure 5 : Stratigraphic log of the Malabena Sandstone Member

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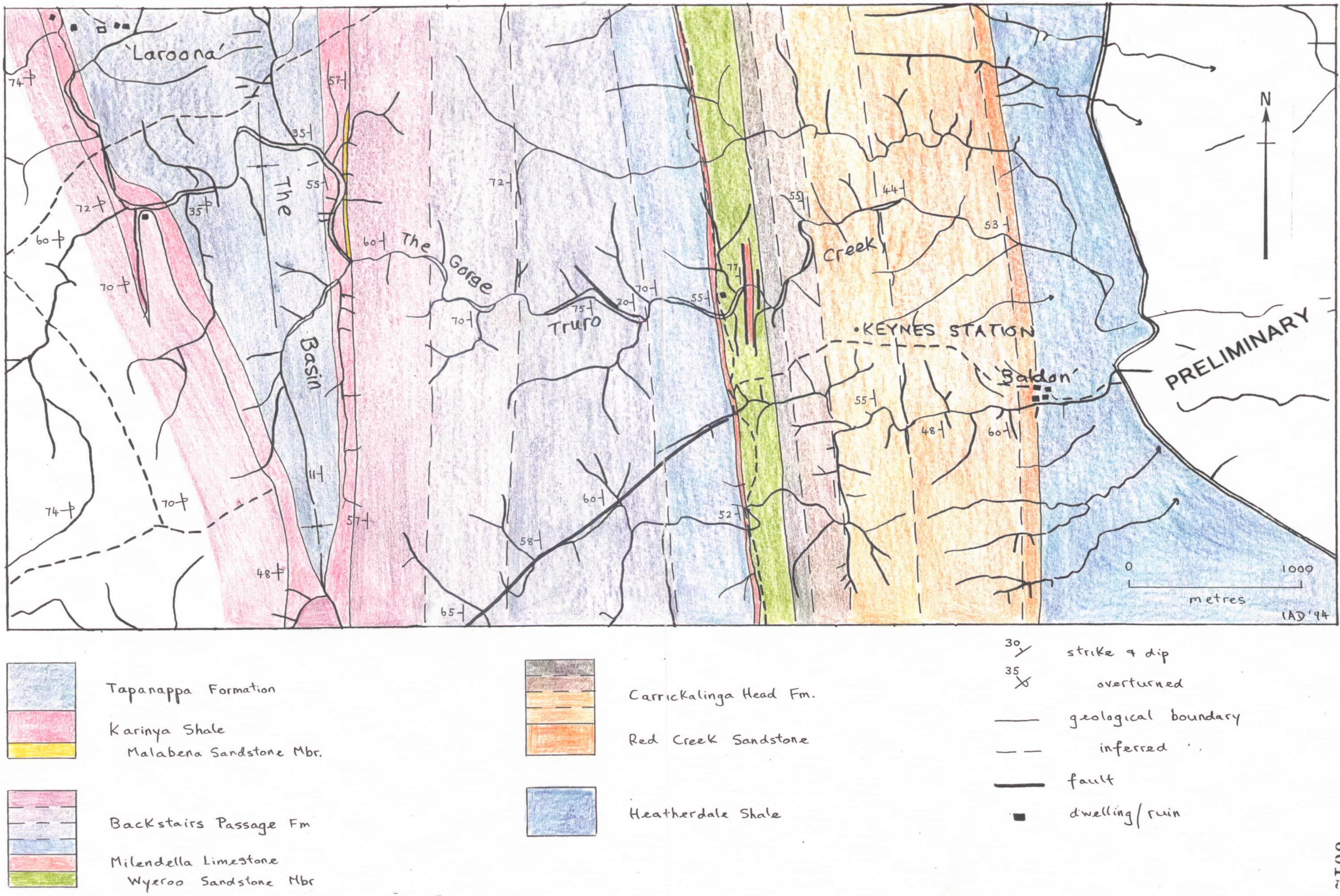
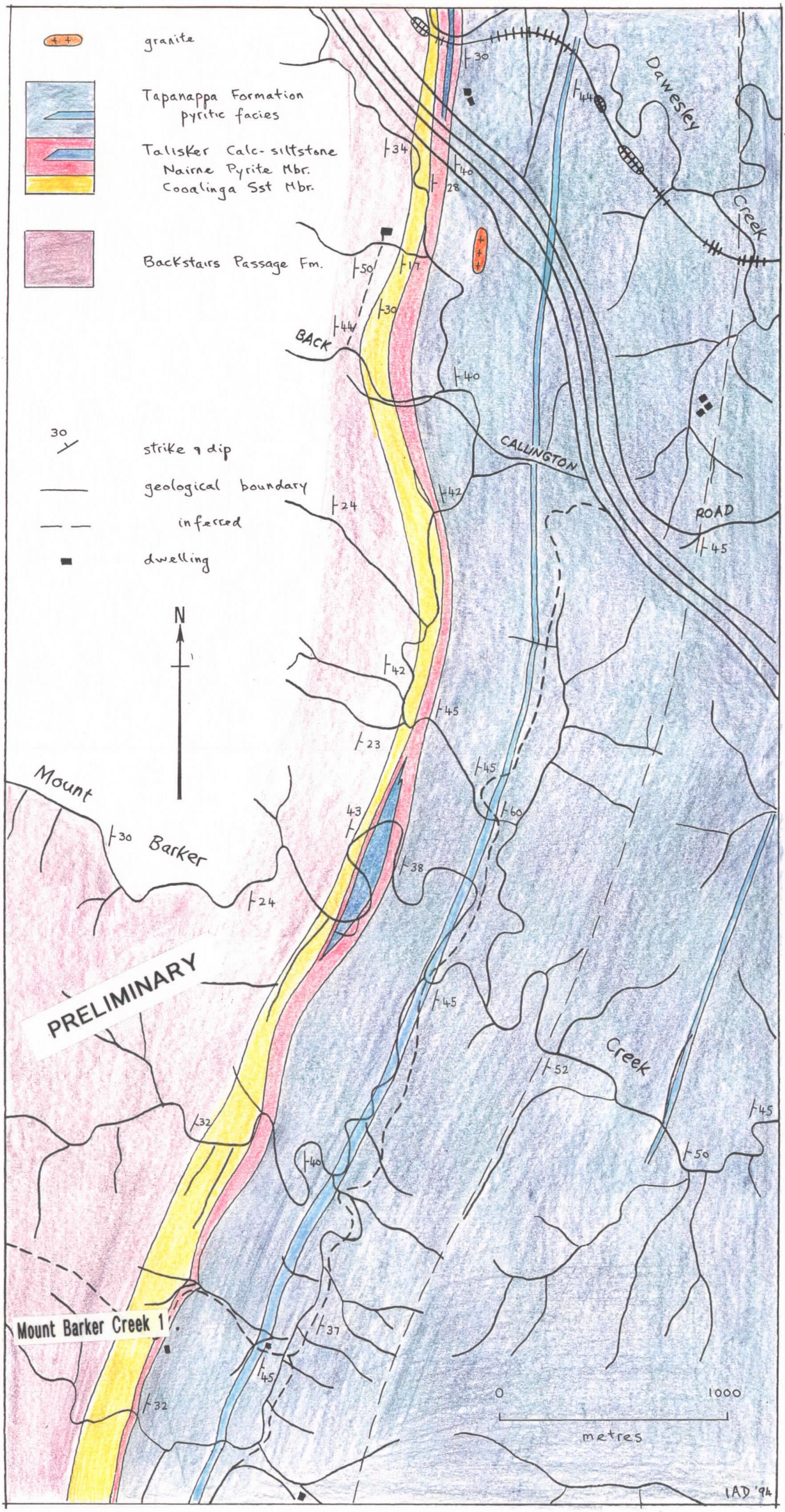
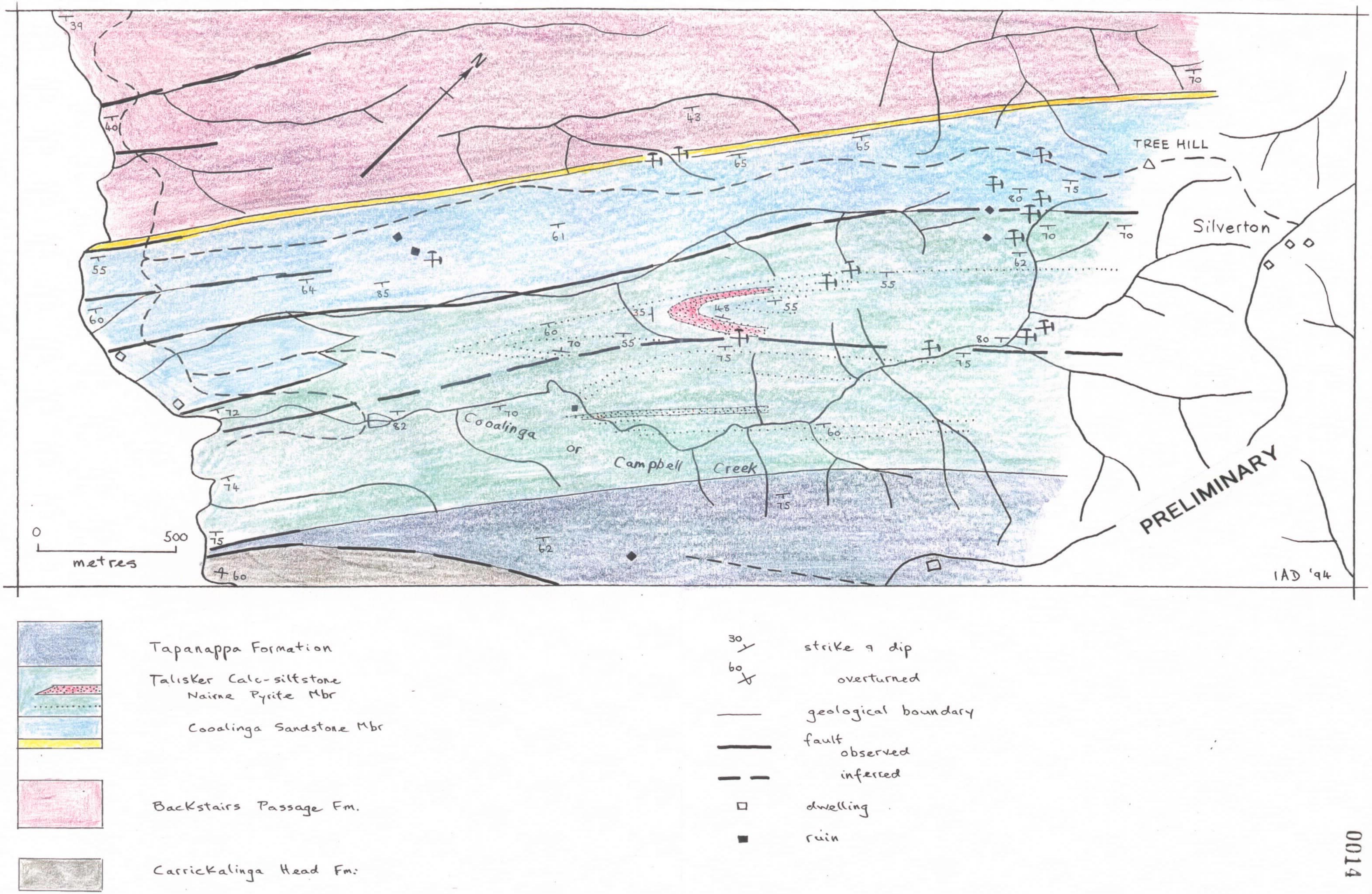
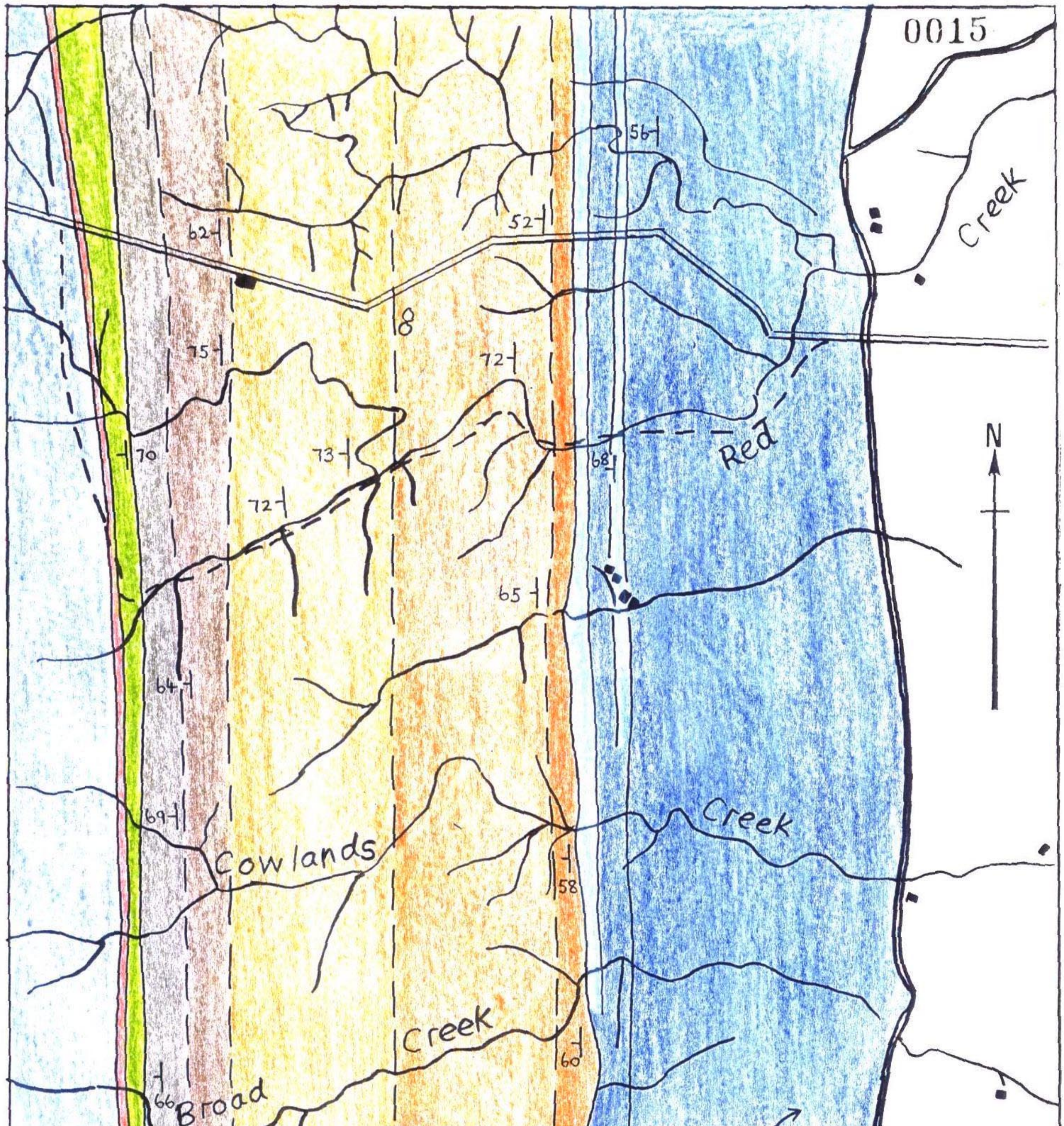


'Laroona'
The Basin
The Gorge
Truro
Creek
KEYNES STATION
'Baldon'
PRELIMINARY
N
0
1000
metres
IAD'94
Tapanappa Formation
Karinya Shale
Malabena Sandstone Mbr.
Backstairs Passage Fm
Milendella Limestone
Wyeroo Sandstone Mbr
Carrickalinga Head Fm.
Red Creek Sandstone
Heatherdale Shale
30 strike & dip
35 overturned
geological boundary
inferred
fault
dwelling/ruin


granite
Tapanappa Formation
pyritic facies
Talisker Calc-siltstone
Nairne Pyrite Mbr.
Cooalinga Sst Mbr.
Backstairs Passage Fm.
strike & dip
geological boundary
inferred
dwelling
N
PRELIMINARY
Mount Barker Creek 1
Mount Barker Creek
BACK
CALLINGTON ROAD
Dawesley Creek
Creek
0
1000
metres
IAD '94


N
TREE HILL
Silverton
Cooalinga or Campbell Creek
PRELIMINARY
0
500
metres
IAD '94
Tapanappa Formation
Talisker Calc-siltstone
Nairne Pyrite Mbr
Cooalinga Sandstone Mbr
Backstairs Passage Fm.
Carrickalinga Head Fm.
30
strike & dip
60
overturned
geological boundary
fault
observed
inferred
dwelling
ruin



Backstairs Passage Fm.

Milendella Limestone

Wyeroo Sandstone Mbr.

Carrickalinga Head Fm.

Red Creek Sandstone

Heatherdale Shale

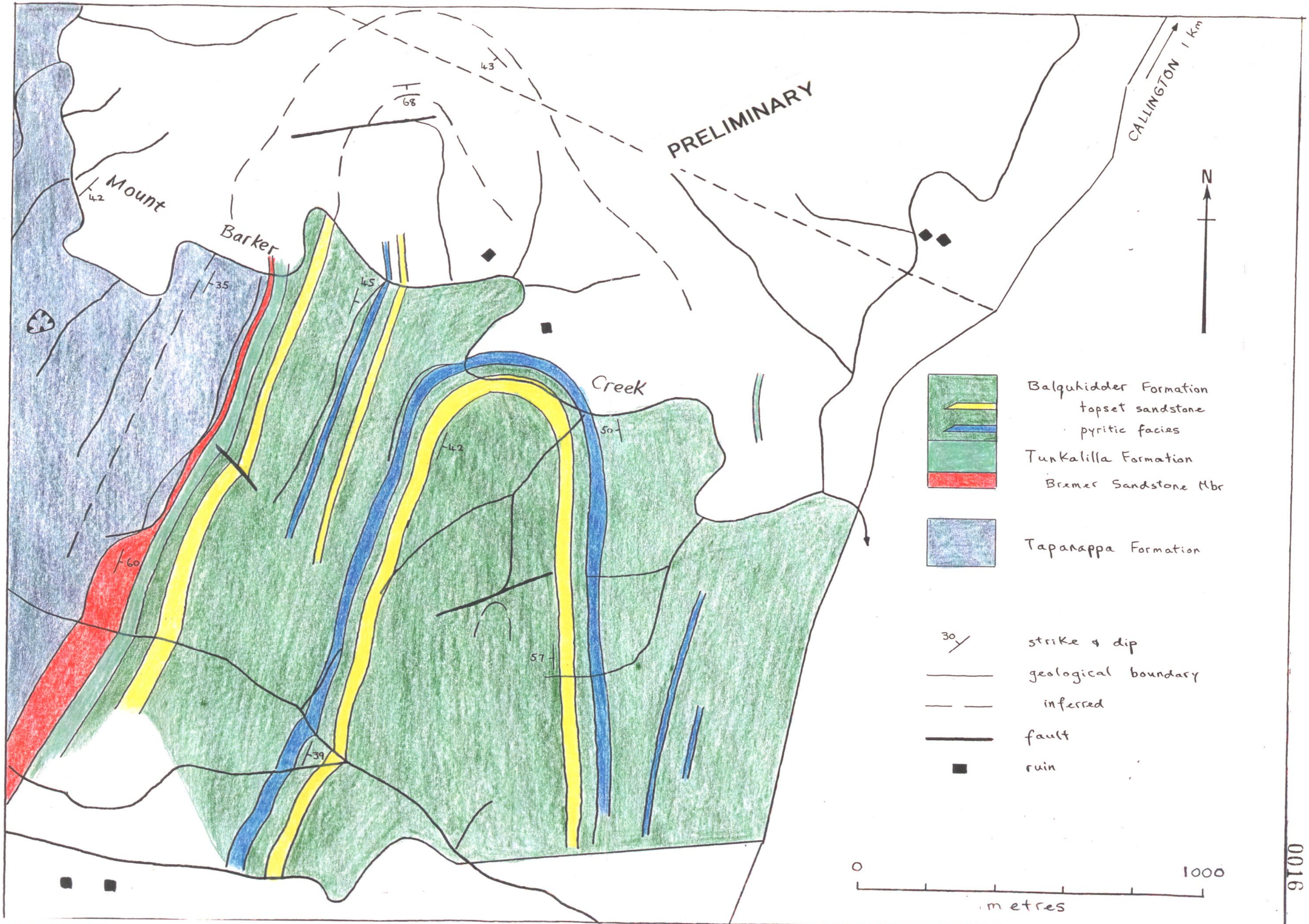
volcanics

30 strike & dip

geological boundary

inferred

dwelling/ruin


PRELIMINARY
CALLINGTON 1 Km
N
Mount Barker Creek
43
68
42
35
45
42
50
60
57
39
Balquhidder Formation
topset sandstone
pyritic facies
Tunkalilla Formation
Bremer Sandstone Mbr
Tapanappa Formation
30
strike & dip
geological boundary
inferred
fault
ruin
0
1000
metres

0016