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Marine Geoscience Programme

Open Report OR/11/028

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P Stone

Keywords

Diamictite, Gondwana, Lafonia Group, East Falkland, Permo-Carboniferous glaciation, erratics.

Front cover

A mineral exploration drilling rig at work in Ceritos Arroyo, to the north-west of Black Rock, East Falkland, in November 2005. BGS image P605052.

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Foreword

This report provides details and background information for borehole cores and rock specimens recovered from the Falkland Islands, South Atlantic Ocean, during a mineral exploration programme. The borehole cores illustrate aspects of the Late Carboniferous to Early Permian Fitzroy Tillite and Port Sussex formations and have been lodged in the collections of the British Geological Survey, Keyworth. The diamictite of the Fitzroy Tillite Formation is the representative from the Falkland Islands of glacigenic strata deposited extensively during Gondwana-wide glaciation. It is overlain by the Hells Kitchen Member of the Port Sussex Formation, a member that comprises the transitional, thinly interbedded diamictite-siltstone-mudstone, deglaciation succession which passes up into post-glacial, anoxic black mudstone. The rock specimens are mostly erratic clasts from the glacigenic diamictite; a broad range of lithologies is represented by the clasts, with some at least thought to have originated in East Antarctica prior to the break-up of Gondwana. The acquisition and interpretation of the borehole core and rock specimens formed part of a geological consultancy programme by the British Geological Survey, under the leadership of Dr Phil Richards, on behalf of the Department of Mineral Resources, Falkland Islands Government.

Acknowledgements

Falklands Gold and Minerals Ltd are thanked for making available the core sampled and described in this report; the assistance of Derek Reeves, the project manager, is particularly acknowledged. Essential assistance to the sampling exercise was given by the British Antarctic Survey, through the provision of flat-pack wooden sample boxes, and then transport of the same, filled with core specimens, back to the UK. In the Falkland Islands, logistical support was provided by the Departments of Agriculture and Mineral Resources directed by Mrs Phyl Rendell.

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Summary

Within the Palaeozoic sedimentary succession of the Falkland Islands the Fitzroy Tillite Formation is the local representative of glacigenic strata deposited widely across Gondwana during Late Carboniferous glaciation. In West Falkland, a terrestrial lithofacies contains a wide range of erratic pebbles, cobbles and boulders; in East Falkland a glaciomarine diamictite contains fewer and generally smaller clasts from a more restricted lithological range. At the top of the East Falkland succession is a transitional zone up to about 10 m thick through which the massive diamictite of the Fitzroy Tilllite Formation passes up into the anoxic black mudstone of the Black Rock Member, Port Sussex Formation. The transitional zone – the Hells Kitchen Member of the Port Sussex Formation – features thinly alternating diamictite, mudstone/siltstone with dropstones and laminated mudstone. It records the fluctuating depositional circumstances during deglaciation. Some of the borehole core recovered during a mineral exploration programme illustrated the complete transitional succession from the massive diamictite, through the thinly interbedded lithologies of the Hells Kitchen Member and into the overlying, post-glacial anoxic mudstone. Various runs of borehole core sampling all or part of this interval have been lodged in the collection of the British Geological Survey (BGS), Keyworth. To supplement the borehole core, erratic clast specimens from the diamictite of both East and West Falklands have also been placed in the BGS collection. Clasts of archaeocyath-bearing limestone (of Early Cambrian age) have been discovered in both areas and had a likely provenance in East Antarctica prior to the break-up of Gondwana. The same region may therefore have been the source for some of the other exotic lithologies found as clasts in the diamictite, particularly in West Falkland.

1 Introduction

The Falkland Islands lie in the South Atlantic Ocean, approximately 650 km east from the Strait of Magellan, around 52° south, 60° west. Conjecturally Silurian to unequivocally Devonian (and perhaps Carboniferous), near-shore, clastic marine strata of the West Falkland Group (Aldiss & Edwards 1999; Hunter & Lomas 2003) form the lower part of the islands' sedimentary succession, which rests unconformably on a Proterozoic crystalline basement - the Cape Meredith Complex (Fig. 1). The West Falkland Group is succeeded by the Carboniferous to Permian, mainly marine to lacustrine clastic strata of the Lafonia Group (Aldiss & Edwards 1999; Trewin *et al*. 2002). Near the base of the Lafonia Group is a glacigenic unit, the Fitzroy Tillite Formation, overlain by the mainly mudstone-siltstone succession of the Port Sussex Formation. The overall stratigraphy shows great similarity to the coeval Palaeozoic successions of South Africa, South America and Antarctica that were deposited contiguously when these present-day continents formed adjacent parts of the Gondwana supercontinent.

2 The Fitzroy Tillite Formation

The Fitzroy Tillite Formation is the representative in the Falkland Islands of the late Carboniferous to early Permian glacigenic diamictite that is widespread across the fragments of Gondwana, recording a glacial episode about 290 million years ago (Crowell 1999; Veevers & Powell 1987). Gondwana began to break up about 200 million years ago and continental fragments were dispersed, each fragment with its own contemporaneous part of the tillite succession: the Dwyka Tillite in South Africa, the Sauce Grande Formation in Ventania, Argentina, the Whiteout Conglomerate in the Ellsworth Mountains, Antarctica, with distant equivalents also seen in Australia and India. The broad correlation between these different sequences is well established (e.g. Caputo & Crowell 1985; Matsch & Ojakangas 1992) but the detail is complicated by the migration of the ice dispersal centres as Gondwana drifted across the southern polar region (Crowell & Frakes 1972; Caputo & Crowell 1985).

The diamictite lithology in the Falkland Islands was first noted and described in the early 1840s by Bartholomew Sulivan whilst in command of the surveying vessels HMS *Arrow* and HMS *Philomel*. He passed his observations on to Charles Darwin who included a reference to 'conglomerate' in a footnote to his 1846 paper 'On the Geology of the Falkland Islands', though the glacigenic origin was not appreciated at the time (Darwin 1846). The recognition that the lithology was a glacially-deposited tillite equivalent to similar deposits elsewhere in Gondwana came later, with the work of Halle (1912) and Baker (1924), the latter introducing the stratigraphical name 'Lafonian Tillite'. The unit was described in detail and its definition formalized as the Fitzroy Tillite Formation by Aldiss & Edwards (1999) who noted that the name 'Lafonia(n)' was preoccupied by the Lafonia Group, and that the tillite formation did not actually crop out in the Lafonia geographical region (Figure 1).

Lithological differences between the diamictites of East and West Falklands had been noted by Sulivan, who doubted their correlation (Darwin Correspondence Project, Letters 675 and 730). Much later, a comprehensive study by Frakes & Crowell (1967) related the differences between the East and West Falkland outcrops to different depositional environments. In the west, a grey-green, brown-weathering, sandy mudstone matrix contains and supports a variety of locally-derived and exotic rock clasts (Figure 2), mostly as small pebbles but ranging up to boulders 7 m

across. This West Falkland tillite is regarded as a terrestrial sub-glacial deposit within which included sand bodies probably originated as eskers, although there are no convincing examples of subjacent, striated rock surfaces. In the east, a dark grey and fine-grained muddy matrix encloses a sparse assemblage of clasts (Figure 3) that tend to be smaller and of a more restricted lithological range than is seen in the west; the East Falkland tillite was probably deposited in marine conditions under a floating ice sheet. Thickness estimates for the formation vary from about 600 m up to about 900 m.

Whatever the precise depositional process, the clasts in the Fitzroy Tillite Formation were derived from a wide range of rock types, though there is a dominance of quartzite and sandstone, and an important but highly variable granitic component: accessory types include gneiss, garnet-mica schist, dolerite and a wide range of porphyritic hypabyssal rocks, volcanic tuff, ash and agglomerate, amygdaloidal lava, ignimbrite, slate, quartz-pebble conglomerate and limestone (Halle 1912; Baker 1924; Frakes & Crowell 1967; Aldiss & Edwards 1999; Stone & Thomson 2005). Much of the clast assemblage has been loosely ascribed either to the Siluro-Devonian sequence forming the West Falkland Group or to the Proterozoic basement represented by the Cape Meredith Complex (Frakes & Crowell 1967), although a substantial proportion of the clasts are acknowledged to have no known local source. Quantitative descriptions of the overall clast assemblage are provided by Bellosi & Jalfin (1984) from the Black Rock area of East Falkland (Fig. 1), and by Frakes & Crowell (1967) consolidated from a range of localities, mostly on East Falkland but including four West Falkland sites. The results reported are similar: Bellosi & Jalfin list 60% quartzite, 15% sandstone and 17% granitoid; Frakes & Crowell list 40% quartzite, 26% sandstone and 18% granitoid. Qualitatively assessed differences between the tillite of East and West Falkland, additional to the well-defined facies contrast, include the size range and lithological variety of accessory clasts, both of which appear to be much greater in the west than in the east; and the much higher proportion of red granite and quartzite, relative to white varieties in the west relative to the east.

The limestone clasts (Figure 4) have proved to be particularly instructive, with many containing an Early Cambrian, Australo-Antarctic archaeocyath fauna (Figure 5) thought to have been derived originally from the Transantarctic Mountains (Stone & Thomson 2005). They are relatively rare overall but in West Falkland are concentrated at certain localities. In the Hill Cove section for example, limestone clasts (ranging up to 45 cm in maximum dimension) were found only at the eastern end around Fox Point; there they are relatively abundant with 22 of the 25 limestone clasts examined in detail proving to contain archaeocyaths. Archaeocyathan limestone clasts appear to be less common in East Falkland than in West Falkland. Although limestone is a widespread (though still rare) accessory in the East Falkland tillite only two limestone clasts have been found to contain archaeocyaths out of the 15 examined (ranging up to 15 cm in maximum dimension). In the West Falkland clasts, the archaeocyaths are commonly visible macroscopically, whereas in the East Falkland clasts the archaeocyaths were discovered only in thin section. The apparent concentration of archaeocyathan limestone clasts at a few localities in West Falkland, rather than their being randomly distributed, is a feature that may have broad stratigraphical and palaeogeographical implications. From East Falkland additional, though rather tentative organic traces are ooids in a clast (BGS specimen LX1003-17: see Appendix 1) collected at Mount Pleasant Quarry (Figure 6); the ooids may have had an algal component to their formation. Frakes & Crowell (1967) also reported ‘oolitic limestone’ as a clast lithology but did not specify where it occurred.

A range of clasts from the Fizroy Tillite Formation have been deposited in the BGS specimen collection as listed in Appendix 1. The fossils recovered from the limestone clasts have been deposited at The Natural History Museum, London (NHM): archaeocyath specimens have the catalogue references NHM PI PO 12074-12110 as listed in Appendix 2; trilobites have references It 28326-28335 but are contained in archaeocyath specimen 12074.

3 The Hells Kitchen Member, Port Sussex Formation

In their comprehensive account of the Fitzroy Tillite Formation, Aldiss and Edwards (1999) described within its upper part a section of thinly interbedded diamictite, sandstone and mudstone (locally containing dropstones) ranging from 5 to 15 m in thickness; this they named the Quark Pond Member from a locality on the east coast of West Falkland. The member would appear to record a temporary and fluctuating glacial regression. A rather similar unit, the Hells Kitchen Member, is generally about 7 m thick and conformably succeeds the Fitzroy Tillite Formation to form the basal unit of the Port Sussex Formation. The base of the Hells Kitchen Member has been generally described as sharp, with the thinly bedded to laminated lithologies resting abruptly on massive, unbedded diamictite of the Fitzroy Tillite Formation. It records the environmental and sedimentological fluctuations during the final phase of glacial regression and is followed abruptly by the post-glacial, anoxic black mudstone of the Black Rock Member, Port Sussex Formation.

4 Acquisition of the borehole core

Mineral exploration drilling in the Falkland Islands between 2005 and 2007 produced a considerable quantity of borehole core. Some of core recovered sampled the massive diamictite of the late Carboniferous Fitzroy Tillite Formation (Figure 7), the transition at the top of the formation into the Hells Kitchen Member (Figure 8), and the succeeding transition into the dark marine mudstone of the Black Rock Member. The fluctuating deglaciation facies in the Hells Kitchen Member is represented by thin, interbedded alternations of glaciomarine diamictite, laminated siltstone with dropstones, and laminated mudstone; some sections have a varve-like appearance. The thickness of the Hells Kitchen Member as seen in the borehole cores ranges up to about 10 metres, whilst its upper and lower boundaries appear more transitional than had been supposed from outcrop evidence. All of the boreholes that sampled this stratigraphical interval were located between Old House Rocks and Black Rock, East Falkland (Figure 1). It is worth noting that within that geographical zone the drilling crews reported an eastward decrease in the size and abundance of clasts in the massive diamictite facies of the Fitzroy Tillite Formation.

Commercial interest in the core declined in 2008 and permission was obtained from the owner, Falklands Gold and Minerals Ltd, to take samples and return them to the UK for assimilation into the national core archive. In view of the direct relevance to current interest in climate change issues, the deglaciation sequence (Hells Kitchen Member) was identified as the principal target for sampling, which was carried out in late November and early December, 2008. Strata in some of the boreholes, particularly those in the south of the survey area, are affected by a pervasive cleavage in which diamictite clasts are deformed. These boreholes were not sampled so that the core specimens recovered from the Hells Kitchen Member and the Fitzroy Tillite Formation

represent only the undeformed and uncleaved lithologies. A few of the individual clast specimens show some deformation parallel to cleavage, see Appendix 1.

The core had been stored at Goose Green, East Falkland, with much stacked in the open (Figure 9). By the time sampling was possible there had been considerable deterioration in the condition of some of the core, with labels lost and core boxes disturbed. This limited the amount that could be usefully recovered and made the exercise somewhat opportunistic, but samples were acquired from 8 boreholes that spanned all or part of the Hells Kitchen Member. In addition, material representative of Falklands geology was acquired from a further 4 boreholes. Sampled sections are detailed below. Borehole numbers relate to the drilling programme of Falklands Gold and Minerals Ltd. Location references refer to the Universal Transverse Mercator Grid (U.T.M.) Zone 21.

5 Boreholes sampling the Hells Kitchen Member and the Fitzroy Tillite Formation

Borehole DD029 [377975 4260500]. 227 m.

For most of its length this borehole ran through mudstone of the Black Rock Member, Port Sussex Formation, passing through the transitional Hells Kitchen Member and into the Fitzroy Tillite Formation towards the base; samples were taken from the 170 m to 223 m interval.

Sampled sections:

Mudstone, Black Rock Member: 170 – 176.4 m.

Inter-laminated mudstone/siltstone/diamictite, Hells Kitchen Member: 176.4 – 181.3 m.

Glaciomarine diamictite, Fitzroy Tillite Formation: 181.3 – 222.8 m.

Borehole DD036 [381370 4261540]. 224 m.

This borehole commenced in the Hells Kitchen Member but soon passed into the massive, glaciomarine diamictite of the Fitzroy Tillite Formation; samples were taken from the 9-51 m interval.

Sampled sections:

Inter-laminated mudstone/siltstone/diamictite, Hells Kitchen Member: 9-24 m.

Glaciomarine diamictite, Fitzroy Tillite Formation: 25-51 m.

(Note possible synsedimentary slump features at 28.5 – 35.5 m.)

Borehole DD090 [374470 4261720]. 395 m.

For most of its length this borehole ran through mudstone of the Black Rock Member, Port Sussex Formation, passing through the transitional Hells Kitchen Member and into the underlying Fitzroy Tillite Formation. The mudstone in the upper part of the Black Rock Member is black, carbonaceous and pyritic; this lithology was sampled in the 153.8 – 161.8 m interval. A

dark grey mudstone forms the lower part of the member, passing at about 385.5 m into the transitional Hells Kitchen Member, which in turn overlies diamictite of the Fitzroy Tillite Formation at 392 m.

Sampled sections:

Black, carbonaceous and pyritic mudstone, Black Rock Member: 153.8 – 161.8 m.

Mudstone, Black Rock Member: 375 -383.5 m.

Inter-laminated mudstone/siltstone/diamictite, Hells Kitchen Member: 383.5 - 392 m.

Glaciomarine diamictite, Fitzroy Tillite Formation: 392-395 m.

Borehole DD091 [375460 4261420]. 296 m.

For most of its length this borehole ran through mudstone of the Black Rock Member, Port Sussex Formation, passing through the transitional Hells Kitchen Member and into the Fitzroy Tillite Formation towards the base; samples were taken from the 286 m down to the bottom of the borehole at 296 m.

Sampled sections:

Inter-laminated mudstone/siltstone/diamictite, Hells Kitchen Member: 286 - 294 m.

Glaciomarine diamictite, Fitzroy Tillite Formation: 294 - 296 m.

Borehole DD092 [376460 4260850]. 149 m.

For most of its length this borehole ran through mudstone of the Black Rock Member, Port Sussex Formation, passing into the transitional Hells Kitchen Member at about 141.5 m. Samples were collected from the 140 m to 146.7 m interval.

Sampled sections:

Mudstone, Black Rock Member: 140 – 141.5 m.

Inter-laminated mudstone/siltstone/diamictite, Hells Kitchen Member: 141.5 – 146.7 m.

Borehole DD101 [370236 4267082]. 197 m.

For most of its length this borehole ran through mudstone of the Black Rock Member, Port Sussex Formation, passing through the transitional Hells Kitchen Member and into the Fitzroy Tillite Formation towards the base; samples were taken from the 167 m to 190.6 m interval.

Sampled sections:

Mudstone, Black Rock Member: 167 -176 m.

Inter-laminated mudstone/siltstone/diamictite, Hells Kitchen Member: 176 – 187.5 m.

Glaciomarine diamictite, Fitzroy Tillite Formation: 187.5 – 194.2 m.

Borehole DD114A [372900 4267100]. 149 m.

Only a limited part of this borehole was available but it appears to show the glaciomarine diamictite of the Fitzroy Tillite Formation becoming layered towards the bottom of the sequence drilled. A limited run of core was recovered, from 123 to 125 m, to illustrate the lithology.

Borehole DD202 [371571 4266720]. 98 m.

This borehole commenced in the Hells Kitchen Member and towards its base passed into glaciomarine diamictite of the Fitzroy Tillite Formation. An interval of the Hells Kitchen Member was recovered.

Sampled sections:

Inter-laminated mudstone/siltstone/diamictite, Hells Kitchen Member: 11-19 m.

Borehole DD205 [371740 4266710]. 248 m.

This is the only borehole that appears to sample a thinly bedded unit within the massive diamictite of the Fitzroy Tillite Formation, but even then the possibility cannot be completely ruled out that the tillite in the upper part of the borehole is separated by a fault from an "underlying" sequence in which the Hells Kitchen Member passes down into diamictite.

Sampled sections:

Glaciomarine diamictite, Fitzroy Tillite Formation: 127 – 131.5 m.

This contact may possibly be faulted.

Inter-laminated mudstone/siltstone/fine-grained diamictite: 131.5 -132 m.

Glaciomarine diamictite: 132 – 135.5 m.

6 Boreholes sampling non-glacigenic units

Borehole DD041 [335850 4232500]. 338 m.

This borehole runs through Permian sandstone of the Bay of Harbours Formation, Lafonia Group. Towards the bottom of the borehole the sandstone is intruded by a dolerite dyke of early Cretaceous age.

Representative sandstone samples were taken at about 290, 298, 301 and 302 m.

Dolerite was sampled at about 326 m.

Borehole DD068 [398000 4274400]. 296 m.

This borehole records an inverted sequence. It commences in Devonian micaceous sandstone of the Port Philomel Formation and passes down through the inverted succession into Devonian (or early Carboniferous) quartzite of the Port Stanley Formation. The contact zone was sampled at metre intervals: the Port Philomel Formation between 128 and137.5 m; the Port Stanley Formation between 137.5 and 142 m.

Borehole DD208A [372263 4267520]. 179 m.

This borehole runs through Carboniferous sandstone of the Bluff Cove Formation with the quartzite of the underlying Port Stanley Formation appearing at the very bottom of the hole. Representative sections through the Bluff Cove Formation were sampled between 78.7 m and 80.3 m, and between 115.2 and 116.2 m.

Borehole DD300 [274412 4235650]. 266 m.

This was one of the few boreholes put down in West Falkland. It ran through Siluro-Devonian quartz-arenite of the Port Stephens Formation and an intrusive dolerite dyke, presumed to be early Jurassic but just possibly early Cretaceous in age. The dolerite was sampled at 221m, 230m and 270m, and its contact with the Port Stephens Formation was sampled at 270.5m.

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Appendix 1

Clast specimens recovered from the Fitzroy Tillite Formation and held in the collection of the British Geological Survey, Keyworth, Nottingham

Location LX1003 – Quarry close to Mount Pleasant Airport, East Falkland.
Lat. 51° 49.30’ South. Long. 58° 29.00’ West.

LX1003-1 to LX1003-5: micaceous, felsic schist
LX1003-6 to LX1003-9: felsic gneiss
LX1003-10 to LX1003-11: coarse grained, felsic igneous … ‘granitic’
LX1003-12 to LX1003-14: coarse grained, mafic igneous
LX1003-15: dolerite and garnetiferous quartzite
LX1003-16: garnetiferous quartzite
LX1003-17: ooidal limestone (clast in 4 pieces, a-d)

Location LX1004 – Frying Pan Quarry, East Falkland
(equivalent to PS 303 in Appendix 2)
Lat. 51° 48.54’ South. Long. 58° 19.97’ West.

LX1004-1 to LX1004-2: limestone with traces of archaeocyaths
LX1004-3 to LX1004-5: limestone
LX1004-6 to LX1004-19: coarse grained, felsic igneous … ‘granitic’
LX1004-20: quartzite and coarse grained, felsic igneous
LX1004-21: diorite? and quartzite
LX1004-22: garnetiferous quartzite
LX1004-23: altered basalt? … ‘greenstone’
LX1004-24: felsic gneiss
LX1004-25: felsic schist
LX1004-26: garnet-mica schist

Location LX1005 – Port Harriet Quarry, East Falkland
Lat. 51° 43.50’ South. Long. 58° 01.80’ West.

LX1005-1: glacigenic diamictite, Fitzroy Tillite Formation

Location LX1006 – Boreholes in the vicinity of Old House Rocks, East Falkland

Lat. 51° 44.50’ South. Long. 58° 52.50’ West.

LX1006-1: glacigenic diamictite, Fitzroy Tillite Formation

LX1006-2: glacigenic diamictite, Fitzroy Tillite Formation, clasts deformed in cleavage

LX1006-3: glacigenic laminate with dropstones, Hells Kitchen Member, Port Sussex Fm.
LX1006-4 to LX1006-13: coarse grained, felsic igneous … ‘granitic’

LX1006-14 to LX1006-15: felsic gneiss

LX1006-16: felsic schist

LX1006-17: quartzite

LX1006-18: quartzite and veined felsic porphyry

LX1006-19: limestone, slightly deformed and with possible archaeocyath traces

Location LX1007 – Hill Cove coastal section, West Falkland

Lat. 51° 30.21’ South. Long. 60° 07.51’ West.

LX1007-1 to LX1007-6: gneiss

LX1007-7: garnet-mica schist

LX1007-8: garnetiferous linear (l-) tectonite

LX1007-9: linear (l-) tectonite

LX1007-10: schistose, garnet-rich quartzite

LX1007-11: coarse grained, felsic igneous … ‘granitic’, feldsparphyric

LX1007-12: coarse grained, felsic igneous … ‘granitic’, foliated

LX1007-13: coarse grained, felsic igneous … ‘granitic’

LX1007-14: coarse grained, felsic igneous … ‘granitic’, feldsparphyric

LX1007-15: coarse grained, felsic igneous … ‘granitic’, slight foliation

LX1007-16: coarse grained, felsic igneous … ‘granitic’, red and very coarse grained

LX1007-17: coarse grained, felsic igneous … ‘granitic’, quartz-rich

LX1007-18: coarse grained, felsic igneous … ‘granitic’, foliated

LX1007-19: coarse grained, felsic igneous … ‘granitic’

LX1007-20: quartz

LX1007-21: quartz porphyry, red

LX1007-22: quartz-feldspar porphyry

LX1007-23: coarse feldsparphyric porphyry, red

LX1007-24 and LX1007-25: feldspar porphyry

LX1007-26: amygdaloidal lava, porphyritic basalt?

LX1007-27: amygdaloidal lava, basaltic?

LX1007-28: amygdaloidal lava, andesitic?

LX1007-29: rhyolitic tuff with flow banding?

LX1007-30: ignimbrite? glassy and siliceous in part, recrystallised?

LX1007-31: volcanic tuff or fine agglomerate, andesitic?

LX1007-32: nodular rhyolitic lava?

LX1007-33 and LX1007-34: volcanic breccia/agglomerate

LX1007-35: conglomerate

LX1007-36: laminated volcanic ash

LX1007-37: laminated siltstone/mudstone

LX1007-38: bulk sample of the relatively soft matrix containing the erratic clasts

Location LX1008 – Fox Point West coastal section (Hill Cove), West Falkland
(equivalent to PS 304 in Appendix 2)

Lat. 51° 29.10’ South. Long. 60° 04.65’ West.

LX1008-1 to LX1008-5: limestone with archaeocyaths
(equivalent to PS 304-4 to PS 304-8 in Appendix 2)

Location LX1009 – Fox Point East coastal section (Hill Cove), West Falkland

Lat. 51° 29.10’ South. Long. 60° 03.75’ West.

LX1009-1: bioclastic limestone

LX1009-2: brecciated agate

Appendix 2

Archaeocyath-bearing limestone clasts recovered from the Fitzroy Tillite Formation and held in the collection of The Natural History Museum, London, listing the correlation of working, image and NHM catalogue numbers.

Working number: field collecting localities (Fig. 1) are identified as PS 218 (Port Purvis, West Falkland), PS 303 (Frying Pan Quarry, East Falkland) and PS 304 (Hill Cove, East Falkland); individual clasts collected (when more than one) are identified by the number following the hyphen, e.g. PS 304-8; where more than one thin section was cut from each clast, they are identified by letter, e.g. PS 304-8b; thin sections cut orthogonal to each other are identified by a superscript 1, e.g. PS 304-8b and PS 304-8b[1].

Description: HS = hand specimen; TS = thin section, standard format unless specified as (large), in which case the section is twice the standard size.

BGS image number: reference number for the scanned image of each thin section held in the photographic archive of the British Geological Survey.

NHM catalogue number: Palaeontological Department collection, a dollar sign ($) following the number indicates a thin section.

Working number	Description	BGS image number	NHM catalogue number
PS 218	HS	P 511905, 511906	NHM PI PO 12074
	TS	P 593184	NHM PI PO 12075$
PS 303-1	HS		NHM PI PO 12076
	TS	P 601007	NHM PI PO 12077$
PS 303-2	HS		NHM PI PO 12078
	TS	P 601008	NHM PI PO 12079$
PS 304-1	HS		NHM PI PO 12080
304-1a	TS (large)	P 601009	NHM PI PO 12081$
304-1b	TS	P 601010	NHM PI PO 12082$
304-1c	TS	P 601011	NHM PI PO 12083$
PS 304-2	HS		NHM PI PO 12084
	TS		NHM PI PO 12085$
PS 304-3	HS		NHM PI PO 12086
304-3a	TS	P 601012	NHM PI PO 12087$
304-3b	TS	P 601013	NHM PI PO 12088$
304-3c	TS (large)	P 537735	NHM PI PO 12089$
304-3d	TS		NHM PI PO 12090$
PS 304-4	HS		NHM PI PO 12091

	TS (large)	P 601014	NHM PI PO 12092$
PS 304-5	HS		NHM PI PO 12093
304-5a	TS	P 601015	NHM PI PO 12094$
304-5b	TS	P 601016	NHM PI PO 12095$
PS 304-6	HS		NHM PI PO 12096
	TS	P 601017	NHM PI PO 12097$
PS 304-7	HS		NHM PI PO 12098
304-7a	TS	P 601018	NHM PI PO 12099$
304-7a[1]	TS	P 601019	NHM PI PO 12100$
304-7b	TS	P 601020	NHM PI PO 12101$
304-7c	TS	P 601021	NHM PI PO 12102$
PS 304-8	HS		NHM PI PO 12103
304-8a	TS (large)	P 601022	NHM PI PO 12104$
304-8a[1]	TS (large)	P 601023	NHM PI PO 12105$
304-8b	TS (large)	P 601024	NHM PI PO 12106$
304-8b[1]	TS (large)	P 601025	NHM PI PO 12107$
304-8c	TS	P 601026	NHM PI PO 12108$
304-8d	TS	P 601027	NHM PI PO 12109$
304-8e	TS	P 601028	NHM PI PO 12110$

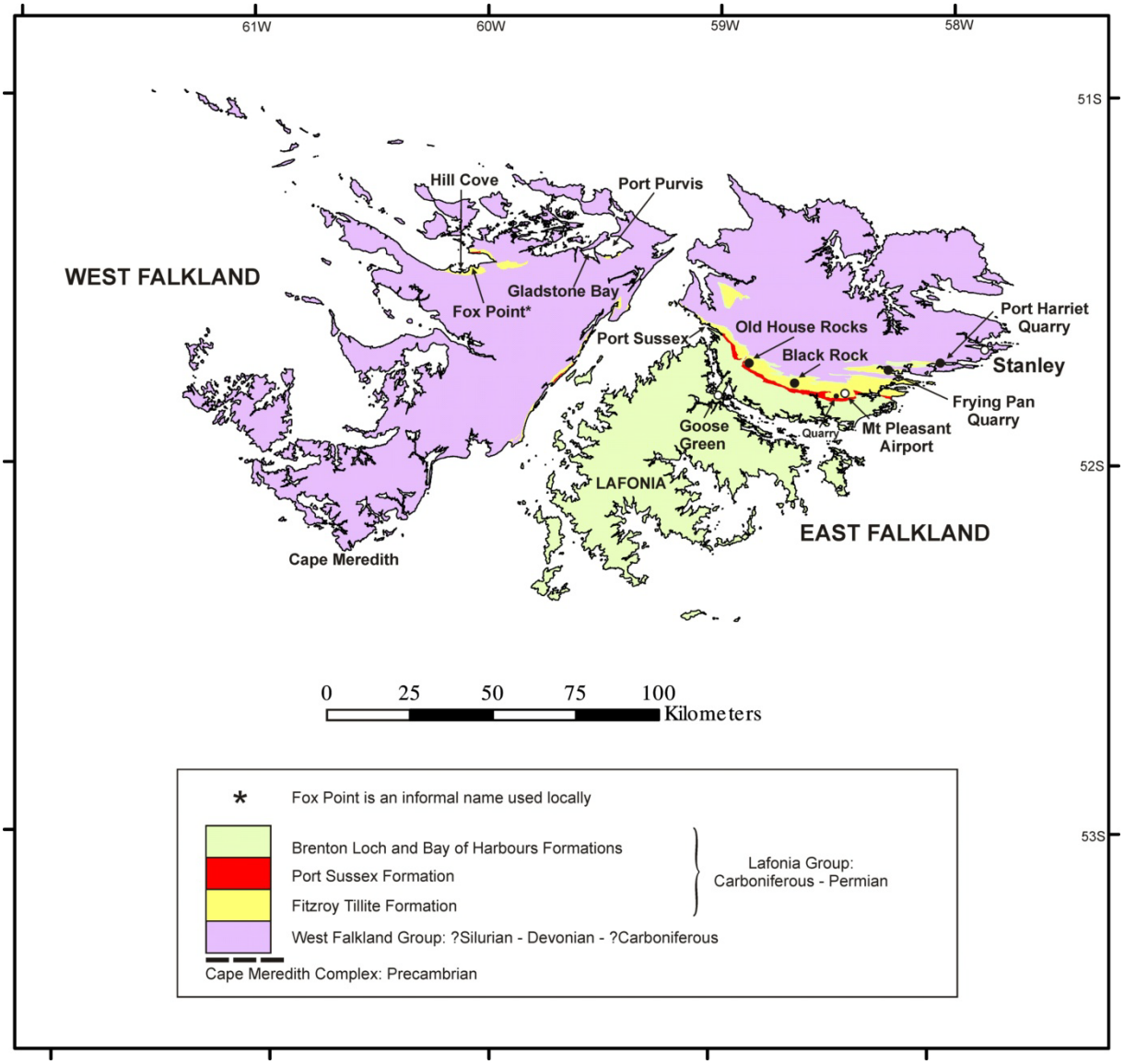

Figure 1: Outline geology of the Falkland Islands showing the outcrop of the Fitzroy Tillite and Port Sussex formations, and the position of the principal sampling localities.

Figure 2: Sub-rounded cobbles of red quartzite and granitic rock in the Fitzroy Tillite Formation at Hill Cove, West Falkland. Author's photograph.

Figure 3: The Fitzroy Tillite Formation as exposed at Frying Pan Quarry, East Falkland. Author's photograph.

Figure 4: The Fitzroy Tillite Formation at Fox Point, West Falkland; the hammer rests against a loose boulder of archaeocyathan limestone eroded from the cliff. Author's photograph.

Figure 5: Archaeocyaths in a limestone clast from the Fitzroy Tillite Formation at Gladstone Bay (Port Purvis), West Falkland. The coin is 2.5 cm in diameter. BGS image P511906.

Figure 6: The quarry in the Fitzroy Tillite Formation close to Mount Pleasant Airport, East Falkland. BGS image P661937.

Figure 7: Borehole core illustrating the massive diamictite facies of the Fitzroy Tillite Formation near Old House Rocks, East Falkland. Core is 6.3 cm in diameter. BGS image P605058.

Figure 8: Borehole core illustrating the thinly interbedded mudstone-siltstone-diamictite facies of the Hells Kitchen Member near Old House Rocks, East Falkland. Core is 4.5 cm in diameter. BGS image P696263.

Figure 9: Borehole core stacked at Goose Green, East Falkland, in February 2008. BGS image P696267.