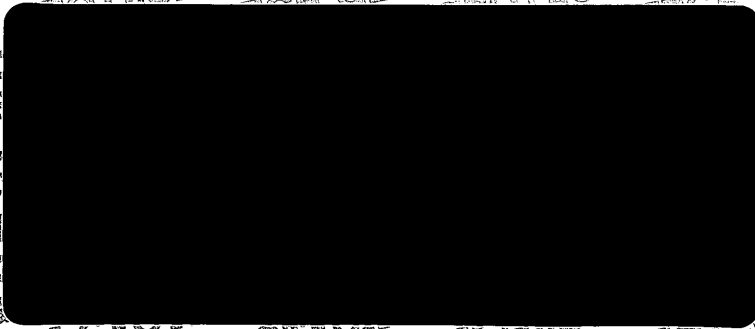


PETROLOGY  
REPORT

DEPT. NAT. RES & ENV  
PE907171



ATTACHMENT TO

WCR

PORT CAMPBELL - 4

W484

W484

**PETROLOGY**  
**PETROLEUM DIVISION**  
**REPORT**  
**15 MAR 1995**  
**PORT CAMPBELL-4**

PETROGRAPHIC ANALYSIS

Prepared for:

GFE Resources Ltd

February, 1995

**GEOTECH** GEOTECHNICAL  
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No indication as to whether the sample depths are in metres or feet has been provided for samples 5459-5458, 7895-7897 and 7900-7902. It has been assumed that they are all in feet, while the depth for sample 2349.7 is in metres.

## **INTRODUCTION**

### **Methods**

A total of four samples have been petrographically analysed within this report. All samples were impregnated with blue coloured resin and then ground to a thickness of 35 microns. After sectioning the samples were stained with Alizarin Red S and Potassium ferricyanide according to the Dickson (1966) method. This stain is used to distinguish between calcite (red), ferroan calcite (blue), dolomite (no stain), and ferroan dolomite (turquoise). Mineral percentages were obtained through visual estimate. Two photomicrographs per sample have been taken so as to highlight the main petrographic features within the thin sections.

## **RESULTS AND INTERPRETATIONS**

### **Rock Types**

All samples are lithic rocks. The samples 2349.7m and 5459'-5458' are massive while a lineation is evident in the samples 7895'-7897' and 7900'-7902'. The lineation is defined by a preferred alignment of the elongate axis of the detrital grains. The rock fragments are predominantly composed of feldspathic volcanics with lesser chert, chalcedony and possible metamorphics.

Compaction and disaggregation of the rock fragments is evident, particularly in the samples 7895'-7897' and 7900'-7902'. A great deal of alteration of the rock fragments has also occurred, resulting in the formation of authigenic chlorite and sericite.

Quartz and feldspar are also present as framework grains. Albite twinned, untwinned and polysynthetic twinned grains are present. A twin extinction angle of between 6° and 8° has been obtained indicating an albite composition.

Authigenic chlorite is located along the margins of the detrital grains and as an alteration within rock fragments. The chlorite is interpreted as having been derived from the in situ alteration of detrital micas and rock fragments. Chlorite is also present in a radiating fibrous form lining primary intergranular pore space. The chlorite appears to have grown into open pore space.

Traces of authigenic zeolite are also present. Accurate identification of the type of zeolite is not possible through optical means, XRD analysis would be needed. However, optically the mineral appears to be stilbite.

### **Porosity and Permeability**

Minor to trace amounts of primary intergranular porosity is present within the samples 2349.7m and 5456'-5458'. The pores are generally lined with fibrous chlorite, reducing the pore space, and in some cases completely infilling it. The chlorite may also result in a low permeability. The pore space has been further reduced by a late stage pore filling material. This material is black and opaque with no indication of its composition being evident. A trace of secondary intragranular pore space has been formed through the partial leaching of partially altered micas.

The samples 7895'-7897' and 7900'-7902' display no porosity. All porosity has been infilled by authigenic clays and authigenic zeolite.

### **Diagenesis**

All samples have undergone a similar diagenetic history although not all stages are represented in all samples. The initial phase of diagenesis was the disaggregation and compaction of detrital rock fragments, this is likely to have occurred prior to cementation. Chloritisation and sericitisation of the detrital grains then followed, this was also probably the main phase of cementation. The fibrous chlorite lining the primary pore spaces was then formed. The final stage of diagenesis was the emplacement of a massive pore filling zeolite.

### **Environmental Indicators**

The only environmental indicator is the possible occurrence of a glauconite in sample 7895-97. This would indicate a marine environment of deposition.

SAMPLE: 5456'-5548'

Mineralogy:

Detrital	Quartz	5%
	Feldspar	5%
	Rock Fragments	77%
Authigenic	Biotite	Trace
	Chlorite	10%
	Sericite	2%
	Opaque Material	Trace
Porosity	Primary	1%
	Secondary	Trace

Description:

The sample is a massive lithic rock. It is grain supported, with grain boundaries displaying point to curved contacts. Cementation appears to be moderately good, with authigenic clays providing the dominant cement.

The dominant framework grains are detrital rock fragments. The grains display a grain size range of fine sand (0.14mm) to coarse sand (0.70mm), with an average of approximately medium sand (0.35mm). Sorting is moderate. The grain shape varies from sub-angular to well rounded, with an average of rounded. The rock fragments are composed of chalcedony, chert, volcanics and possibly metamorphics. Partial disaggregation of the rock fragments is evident, with the grains being compacted between other grains to form a matrix material, this is preferentially associated with the volcanic grains. A great deal of alteration of the rock fragments has occurred, with authigenic chlorite and sericite being formed.

Detrital quartz and feldspar grains are also present as a framework grain. These display a similar size and shape range as that of the rock fragments. The grain shape varies from very angular to sub-rounded, with an average of sub-angular. Albite twinned, polysynthetic twinned and untwinned grains are evident. A twin extinction angle of approximately 8° has been obtained, indicating a albite composition. Sericite alteration of the feldspars is evident.

Authigenic chlorite is located along the margins of the detrital grains and as an alteration within rock fragments. The chlorite is interpreted as having been derived from the in situ alteration of detrital micas and rock fragments. Chlorite is also present in a radiating fibrous form lining primary intergranular pore space. The chlorite appears to have grown into open pore space.

Minor primary intergranular porosity is present. The pores are generally lined with fibrous chlorite, reducing the pore space, and in some cases completely infilling it. The chlorite may also result in a low permeability. The pore space has been further reduced by a late stage pore filling material. This material is black and opaque with no indication of its composition being evident. A trace of secondary intragranular pore space has been formed through the partial leaching of partially altered micas and feldspars.

SAMPLE: 5456'-5458' cont.

Diagenesis:

The initial phase of diagenesis was the disaggregation and compaction of detrital rock fragments, this is likely to have occurred prior to cementation. Chloritisation and sericitisation of the detrital grains then followed, also probably the main phase of cementation. The fibrous chlorite lining the primary pore spaces was then formed. The final stage of diagenesis was the emplacement of the opaque black material.

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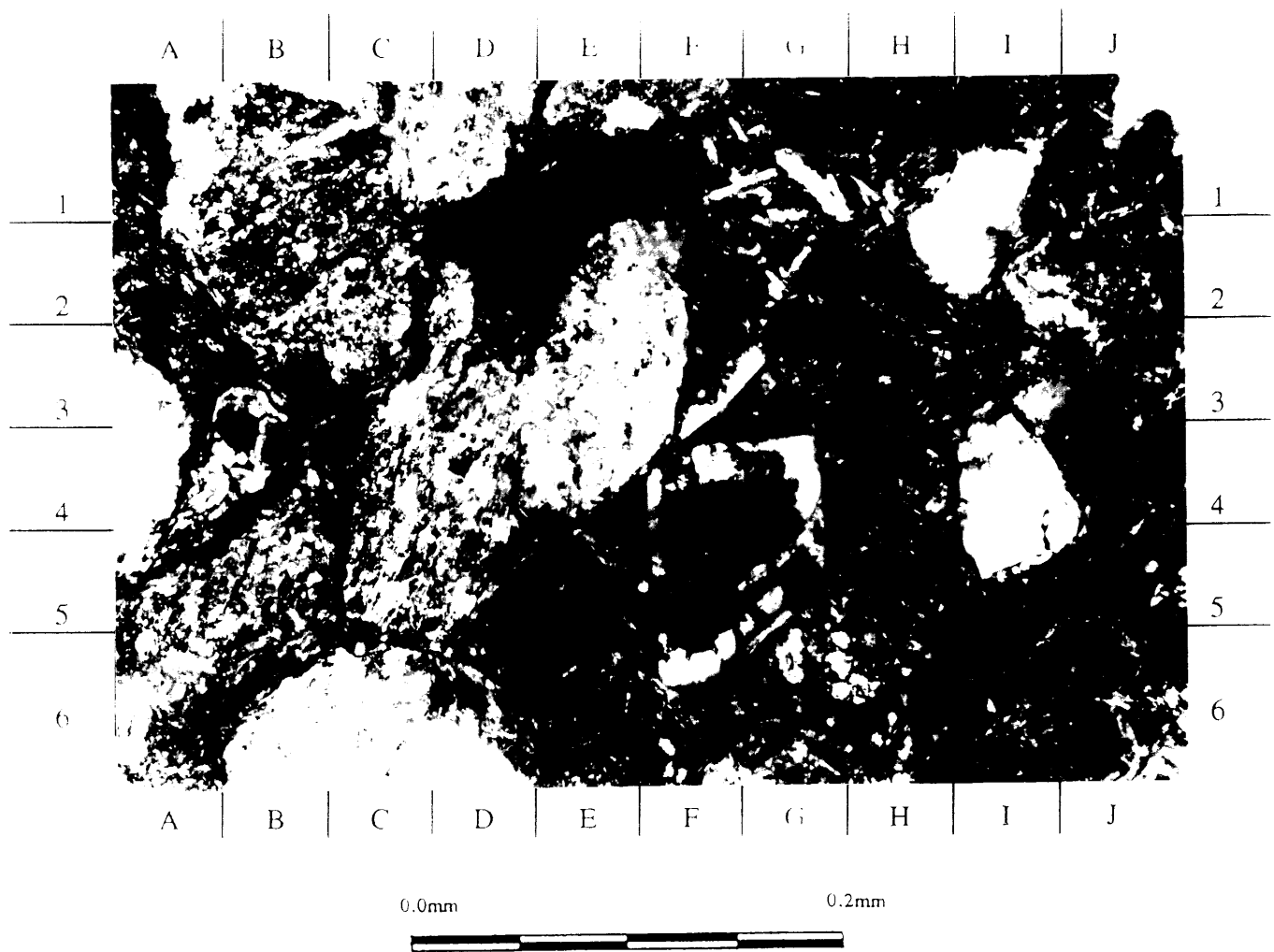


Figure 1 5456'-5458' x192 XPL.

Massive lithic rock. The dominant framework grains are composed of volcanic fragments. Primary intergranular pore space is evident at E2, secondary intragranular porosity is also evident at F5, having formed as a result of the partial leaching of a detrital feldspar grain

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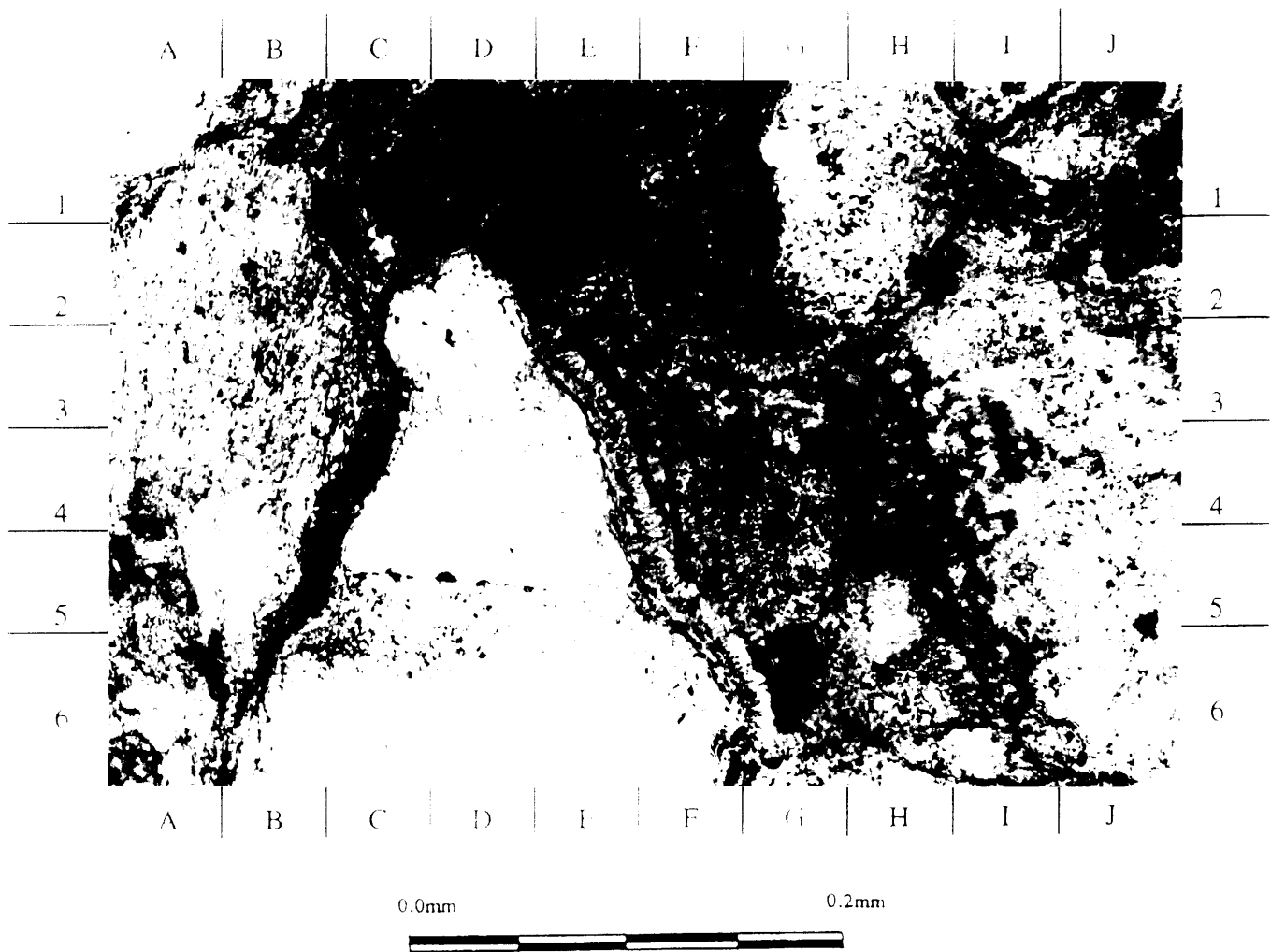


Figure 2 5456'-5458' x192 PPI

Authigenic chlorite is evident coating the detrital framework grains (eg F6) and pore space (G3)

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SAMPLE: 2349.7m

Mineralogy:

Detrital	Quartz	20%
	Feldspar	10%
	Rock Fragments	60%
	Biotite	Trace
Authigenic	Chlorite	8%
	Sericite	2%
	Zeolite (Stilbite)	Trace
Porosity	Primary	Trace
	Secondary	Trace

Description:

The sample is a massive lithic rock. It is grain supported, with grain boundaries displaying point to curved contacts. Cementation appears to be moderately good, with authigenic clays providing the dominant cement.

The dominant framework grains are detrital rock fragments. The grain size is difficult to determine due to the compacted nature of many of the grains. However the maximum grain size is medium sand (0.50mm) and the average is approximately medium sand (0.35mm). Sorting is moderate. The grain shape is difficult to accurately determine due to the compacted nature of the grains. The rock fragments are composed of chalcedony, chert, volcanics and possible metamorphics. Partial disaggregation of the rock fragments is evident, with the grains being compacted between other grains to form a matrix material, this is preferentially associated with the volcanic grains. A great deal of alteration of the rock fragments has occurred, with authigenic chlorite and sericite being formed.

Detrital quartz and feldspar grains are also present as a framework grain. These display a grain size range of very fine sand (0.05mm) to coarse sand (0.61mm), with an average of approximately fine sand (0.20mm). The grain shape varies from very angular to sub-rounded, with an average of sub-angular. Albite twinned, polysynthetic twinned and untwinned grains are evident. a twin extinction angle of approximately 8° has been obtained, indicating an albite composition. Sericite alteration of the feldspars is evident.

Authigenic chlorite is located along the margins of the detrital grains and as an alteration within rock fragments. The chlorite is interpreted as having been derived from the in situ alteration of detrital micas and rock fragments. Chlorite is also present in a radiating fibrous form lining primary intergranular pore space. The chlorite appears to have grown into open pore space.

A trace of authigenic zeolite appears to be present, an accurate identification of the type of zeolite is not possible from optical methods and would require XRD analysis. However, optically the mineral appears to be stilbite. It is present as a massive pore filling material within primary intergranular porosity and secondary intragranular porosity. The zeolite can be seen to post date the fibrous chlorite.

SAMPLE: 2349.7m cont.

Minor primary intergranular porosity is present. The pores are generally lined with fibrous chlorite, reducing the pore space, and in some cases completely infilling it. The chlorite may also result in a low permeability. The pore space has been further reduced by a late stage pore filling zeolite. A trace of secondary intragranular pore space has been formed through the partial leaching of partially altered micas.

Diagenesis:

The initial phase of diagenesis was the disaggregation and compaction of detrital rock fragments, this is likely to have occurred prior to cementation. Chloritisation and sericitisation of the detrital grains then followed, probably the main phase of cementation. The fibrous chlorite lining the primary pore spaces was then formed. The final stage of diagenesis was the emplacement of a massive pore filling zeolite.

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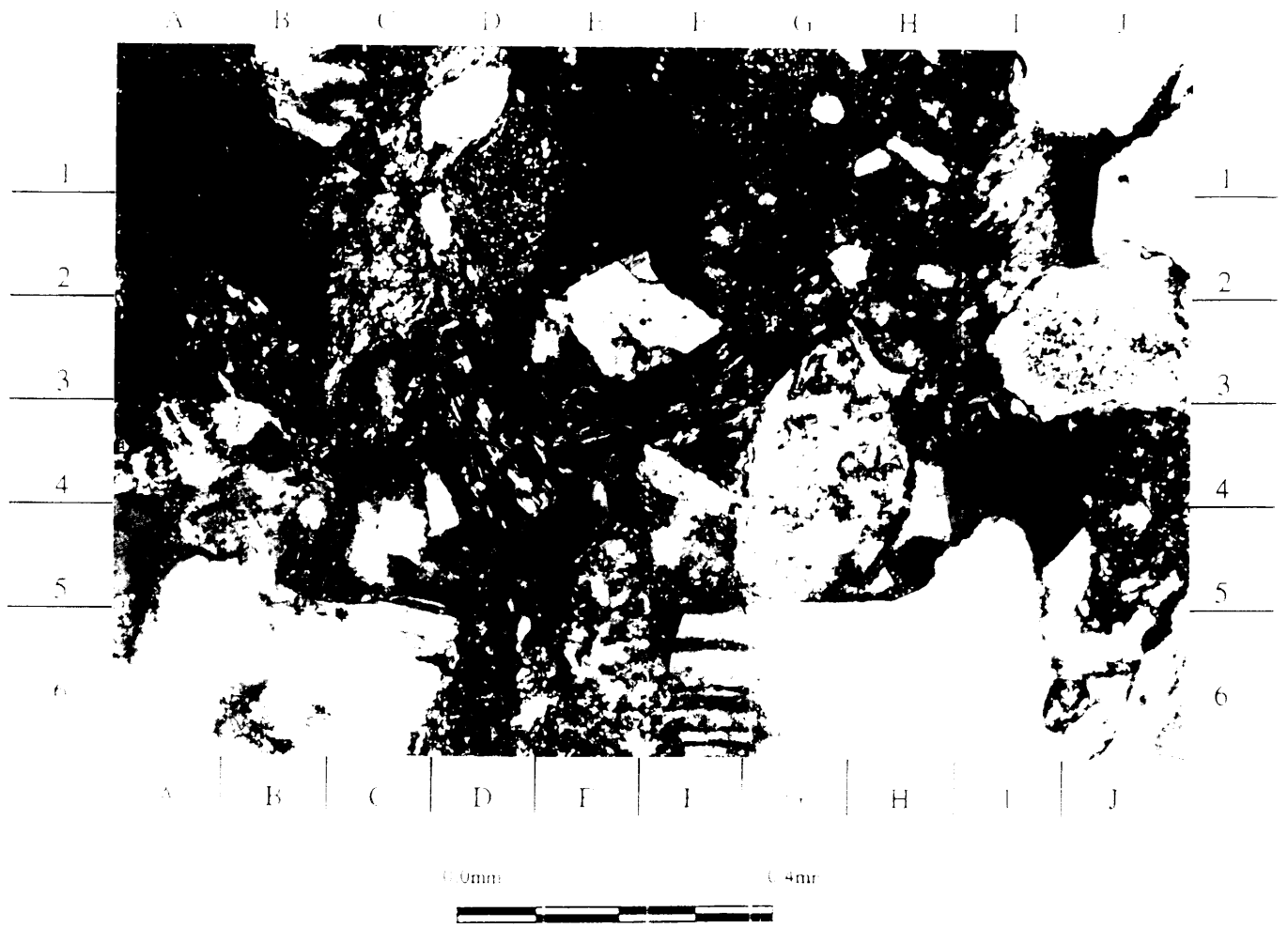


Figure 3 - 2349 7m x75 6 XPL  
Massive lithic rock. The dominant framework grains are composed of detrital volcanic rock fragments.

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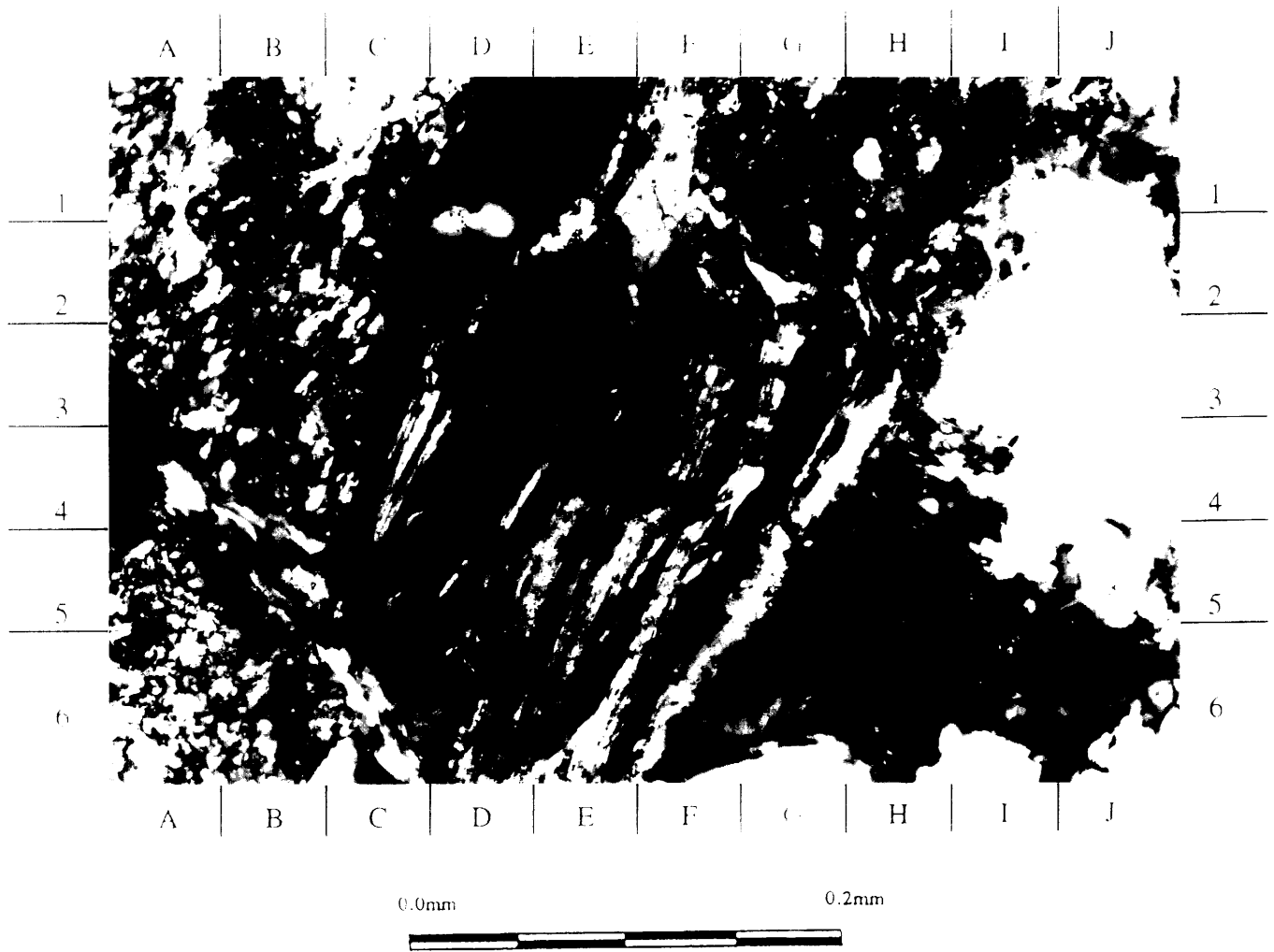


Figure 4 2349 7m x192 XPI  
Detrital biotite grain which has been partially leached and the secondary porosity being  
infiltrated by authigenic zeolite (D5)

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PE907175

SAMPLE: 7895'-7897'

Mineralogy:

Detrital	Quartz	28%
	Feldspar	17%
	Rock Fragments	37%
	Biotite	2%
	Glaucanite	?Trace
Authigenic	Zircon	Trace
	Chlorite	10%
	Sericite	5%
	Zeolite (Stilbite)	1%
	Calcite	Trace
	Opaque	Trace

Description:

The sample is a lithic rock. It displays a lineation, defined by a preferred orientation of the elongate axis of the detrital grains. The sample is both grain and matrix supported, with grain support being dominant. The grain boundaries display point to curved contacts. The matrix is provided by authigenic clays and disaggregated detrital rock fragments. Cementation is moderate, with authigenic clays, zeolites and compaction providing the main cements.

The dominant framework grains are detrital rock fragments. The grain size is difficult to determine due to the compacted nature of many of the grains, however the maximum grain size is medium sand (0.50mm) and the average is approximately fine sand (0.2mm). Sorting is moderate. The grain shape is difficult to accurately determine due to the compacted nature of the grains. The rock fragments are predominantly composed of feldspathic volcanics, with lesser chalcedony, chert, and possibly metamorphics. Partial and complete disaggregation of the rock fragments is common, with the grains being compacted between other grains to form a matrix material, this is preferentially associated with the volcanic grains. A great deal of alteration of the rock fragments has occurred, with authigenic chlorite and sericite being formed.

Detrital quartz and feldspar grains are also present as a framework grain. These display a grain size range of very coarse silt (0.04mm) to medium sand (0.45mm), with an average of approximately fine sand (0.19mm). Sorting appears to be moderately good. The grain shape varies from very angular to sub-rounded, with an average of sub-angular. The quartz grains predominantly display straight to weakly undulose extinctions. Albite twinned, polysynthetic twinned and untwinned grains are evident. A twin extinction angle of approximately  $7^\circ$  has been obtained, indicating a albite composition. Sericite alteration of the feldspars is evident.

Authigenic chlorite is located along the margins of the detrital grains and as an alteration within rock fragments. The chlorite is interpreted as having been derived from the in situ alteration of detrital micas and rock fragments. Chlorite is also present in a radiating fibrous form lining primary intergranular pore space. The chlorite appears to have grown into open pore space, completely filling much of the pore space.

SAMPLE: 7895'-7897' cont.

A trace of authigenic zeolite appears to be present, an accurate identification of the type of zeolite is not possible from optical methods and would require XRD analysis, however, optically the mineral appears to be stilbite. It is present as a massive pore filling material within primary intergranular porosity and secondary intragranular porosity. The zeolite can be seen to post date the fibrous chlorite.

A trace of massive sparry calcite is present. This occurs as a late stage replacement of detrital grains, possibly infilling secondary intragranular pore space produced through the leaching of feldspars.

No porosity is evident or implied. The pores are generally lined with fibrous chlorite, reducing the pore space, and commonly completely infilling it. Any remaining pore space has been occluded by the emplacement of authigenic zeolite.

#### Diagenesis:

The initial phase of diagenesis was the disaggregation and compaction of detrital rock fragments, this is likely to have occurred prior to cementation. Chloritisation and sericitisation of the detrital grains then followed, also probably the main phase of cementation. The fibrous chlorite lining the primary pore spaces was then formed. The next stage of diagenesis was the emplacement of a massive pore filling zeolite. The emplacement of calcite was probably the final stage of diagenesis.

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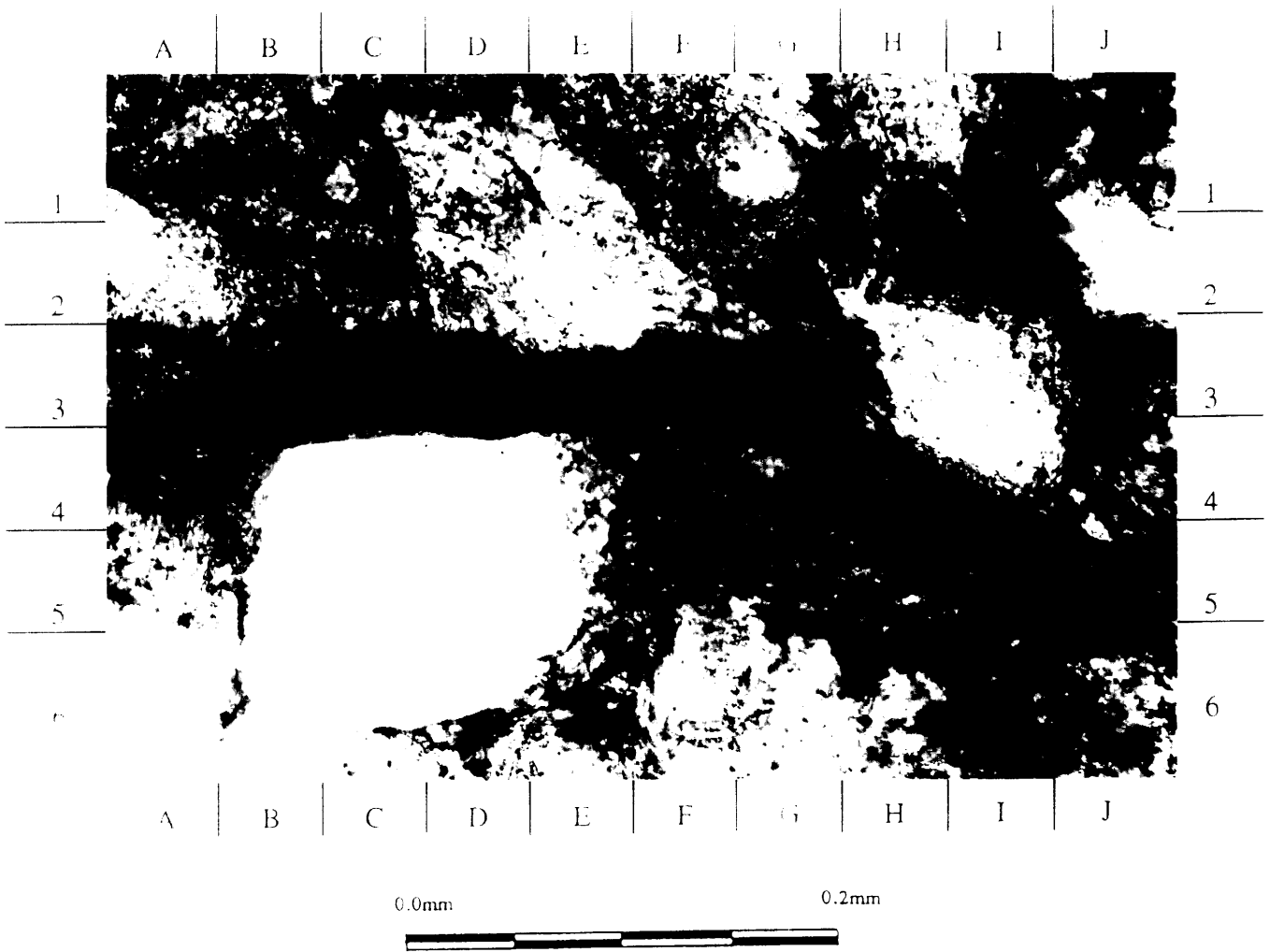


Figure 5 7895'-7897' x192 PPL

Lithic rock with a detrital biotite grain at A3-I5. Partial chloritisation of the detrital biotite is evident. Authigenic chlorite is also evident along the margins of the framework grains.

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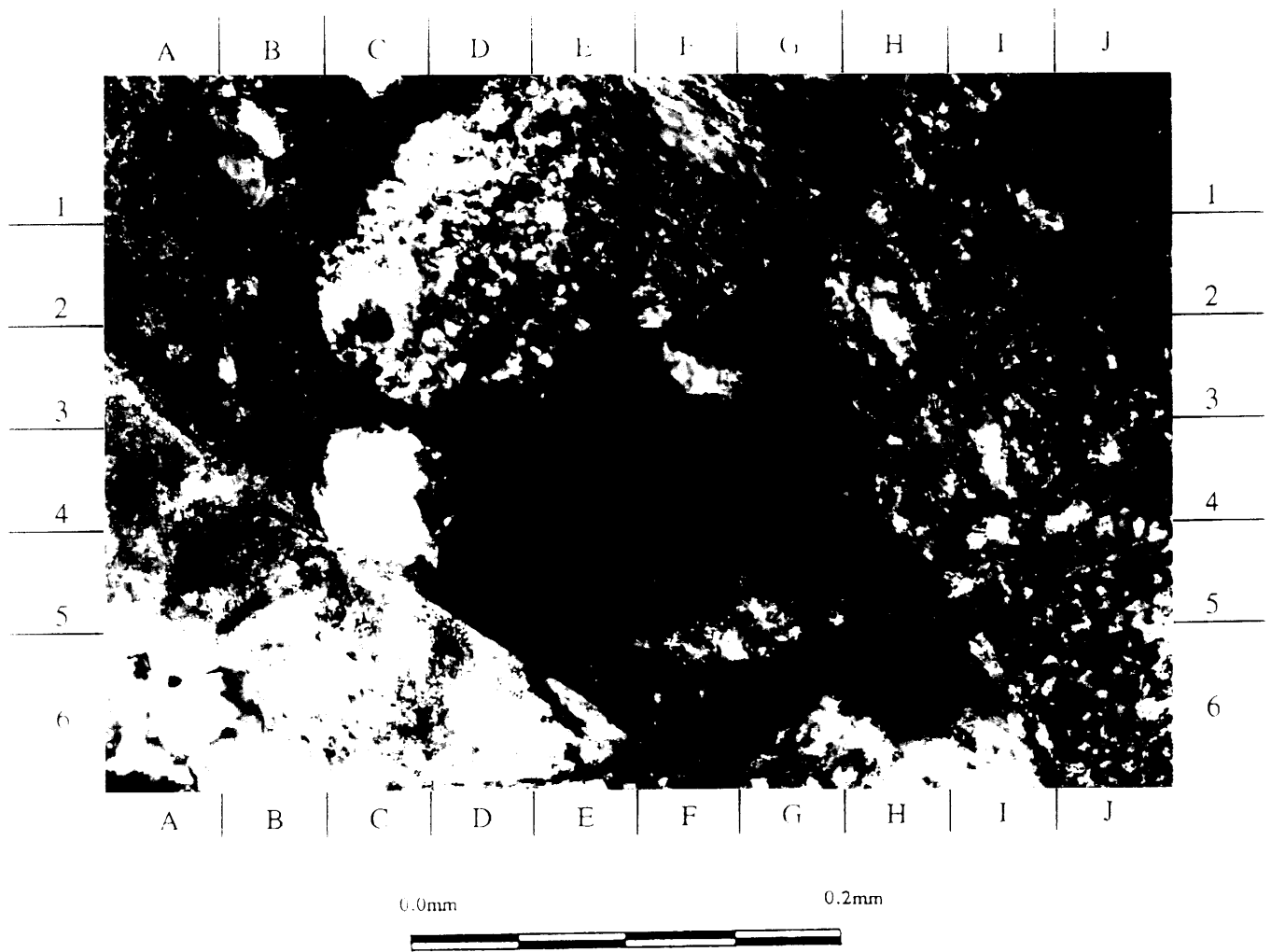


Figure 6 7895'-7897' x192 XPL  
Lithic rock. Detrital rock fragments comprise the dominant framework grains. Authigenic chlorite is evident along the margins of the framework grains and a chloritised mica is present at G1

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SAMPLE: 7900'-7902'

Mineralogy:

Detrital	Quartz	18%
	Feldspar	5%
	Rock Fragments	58%
	Biotite	Trace
Authigenic	Chlorite	10%
	Sericite	4%
	Zeolite (Stilbite)	5%

Description:

The sample is a lithic rock. It displays a weak lineation, defined by a preferred alignment of the elongate axis of the detrital grains. It is predominantly grain supported, with grain boundaries displaying point to curved contacts. Matrix material is provided by authigenic clays and disaggregated detrital grains. Cementation appears to be moderately good, with authigenic clays and zeolite providing the dominant cement.

The dominant framework grains are detrital rock fragments. The grain size is difficult to determine due to the compacted nature of many of the grains, however, it appears to range from fine sand (0.20mm) to medium sand (0.5mm), with an average of approximately medium sand (0.35mm). The grains are generally rounded to sub-rounded and elongate in shape. The rock fragments are predominantly composed of feldspathic volcanics, with lesser chert, chalcedony, and possibly metamorphics. Partial disaggregation of the rock fragments is evident, with the grains being compacted between other grains to form a matrix material, this is preferentially associated with the volcanic grains. A great deal of alteration of the rock fragments has occurred, with authigenic chlorite and sericite being formed.

Detrital quartz and feldspar grains are also present as a framework grain. These display a similar grain size distribution as that of the rock fragments. The grain shape varies from very angular to rounded, with an average of sub-angular. Albite twinned, polysynthetic twinned and untwinned grains are present, a trace of zoned grains are also evident. A twin extinction angle of approximately  $7^{\circ}$  -  $9^{\circ}$  has been obtained, indicating an albite composition. Sericite alteration of the feldspars is evident.

Authigenic chlorite is located along the margins of the detrital grains and as an alteration within rock fragments. The chlorite is interpreted as having been derived from the in situ alteration of detrital micas and rock fragments. Chlorite is also present in a radiating fibrous form lining primary intergranular pore space. The chlorite appears to have grown into open pore space and in many cases has infilled the pore space.

Authigenic zeolite is present, an accurate identification of the type of zeolite is not possible from optical methods and would require XRD analysis, however optically the mineral appears to be stilbite. It is present as a massive pore filling material within primary intergranular porosity and secondary intragranular porosity. The zeolite can be seen to post date the fibrous chlorite.



SAMPLE: 7900'-7902' cont.

No porosity is evident or implied. The pores have been filled with authigenic chlorite and later stage authigenic zeolite.

Diagenesis:

The initial phase of diagenesis was the disaggregation and compaction of detrital rock fragments, this is likely to have occurred prior to cementation. Chloritisation and sericitisation of the detrital grains then followed, also probably the main phase of cementation. The fibrous chlorite lining the primary pore spaces was then formed. The final stage of diagenesis was the emplacement of a massive pore filling zeolite.

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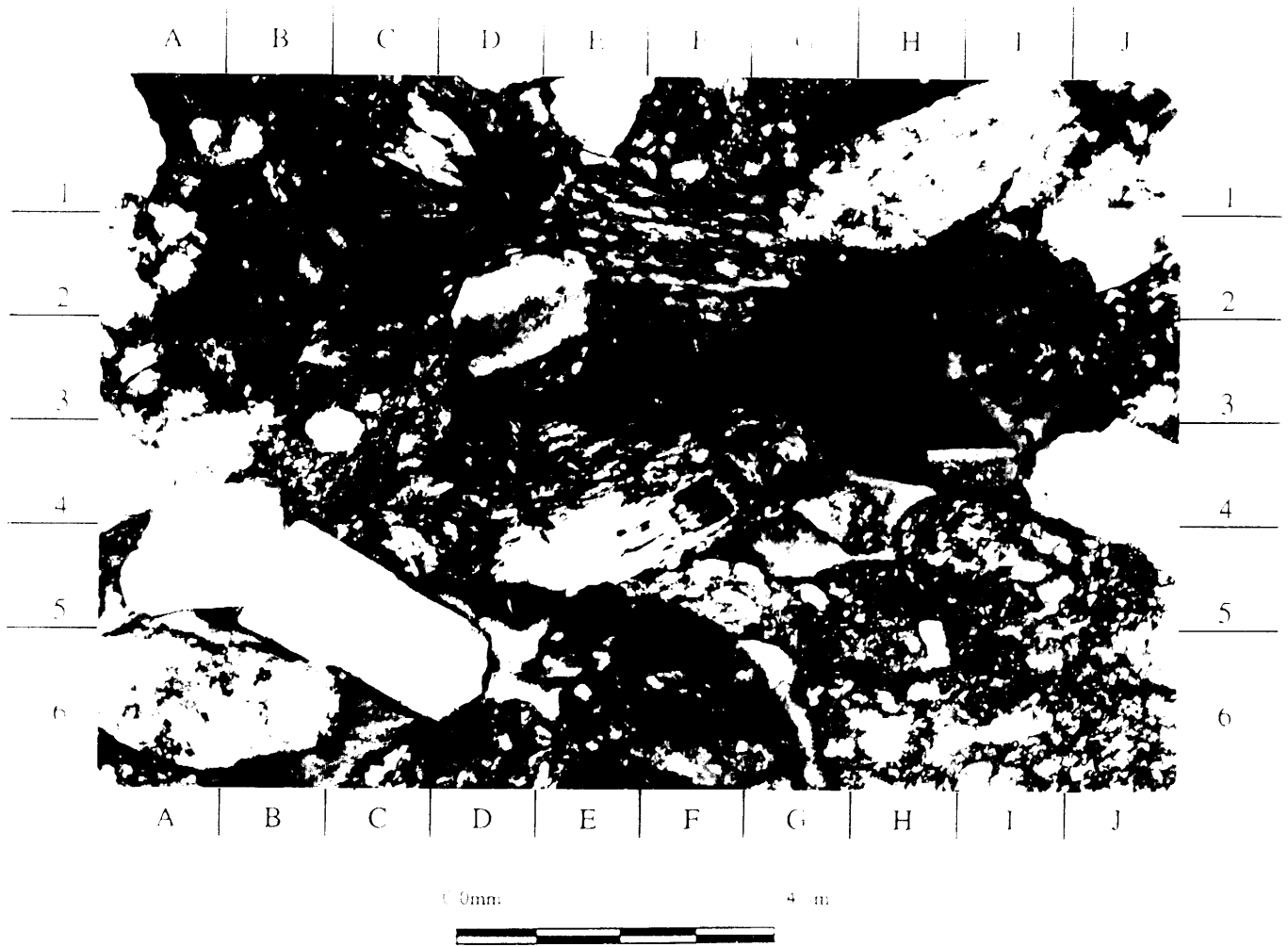


Figure 7 - 7900'-7902' x75.6 NPI  
 Lithic rock. The sample can be predominantly composed of detrital rock fragments. Authigenic zeolite is evident infilling intergranular pore space at D6, C6 and G6.

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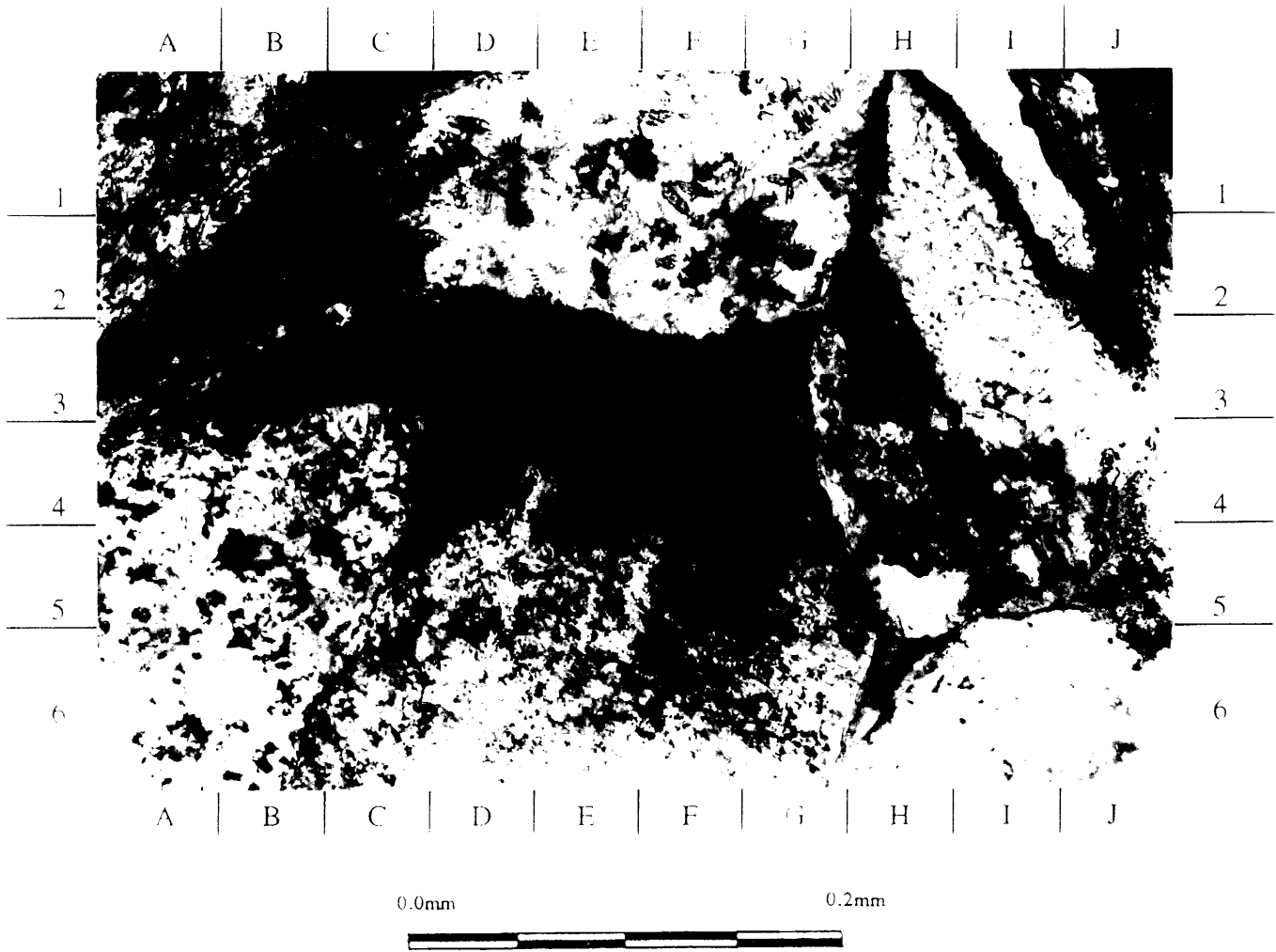


Figure 8 7900'-7902' x192 PPL  
Authigenic chlorite is evident coating detrital framework grains at F3

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