British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Petrographic description and identification of pebble samples from the Permian -Triassic (?Hopwas Breccia Formation), Lichfield Sheet (154)

Mineral Resources
Research Report IR/06/141

G.K. Lott

For
J. Venus
West Midlands Mapping Project

Pebble petrography

Introduction

Sixty-six pebbles from the Triassic pebble beds of the Lichfield area were selected for thin section petrographic examination, in order to determine their lithology and likely provenance areas. The pebbles, which all show reddened ferruginous (possibly also manganiferous) alteration and grain coatings, comprise a range of detrital sandstones, volcaniclastic sandstones, altered igneous grains and sparse metasedimentary rock types.

Sedimentary lithologies

The sedimentary pebbles are dominated by sandstone that can be divided principally into detrital quartzose varieties and volcaniclastic types. The quartzose detrital sandstones range from very fine to coarse-grained varieties whose framework grains are dominated by monocrystalline quartz. A small number of the coarse grained sandstones include very well rounded, millet-seed grains which are of probable eolian origin.

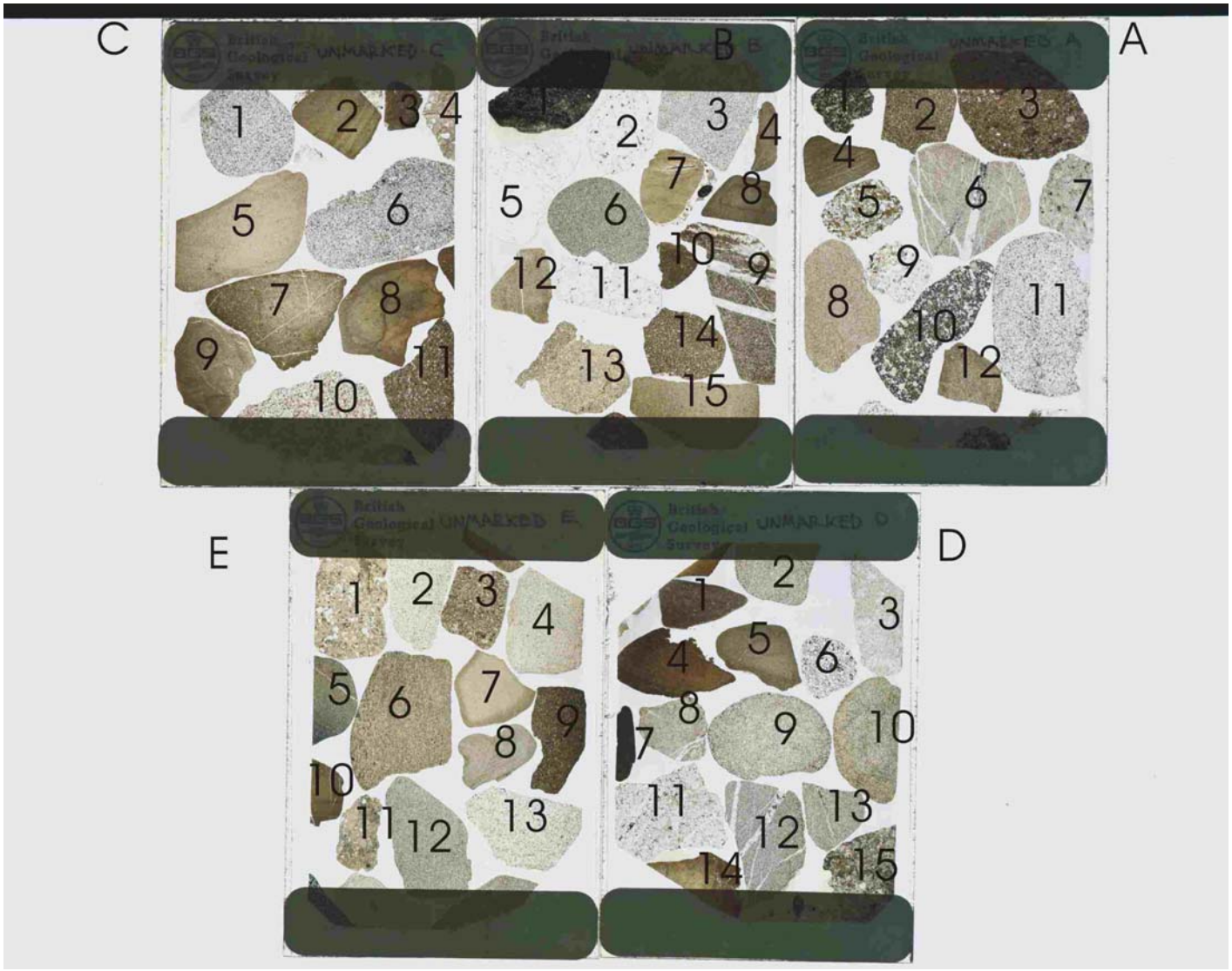
The volcaniclastic sandstones, which are predominantly coarse grained, contain a mixture of framework grain types including variably altered, coarse grained porphyritic types with large euhedral feldspars, finely crystalline basaltic and devitrified glassy grains, together with sub-rounded to angular detrital quartz grains.

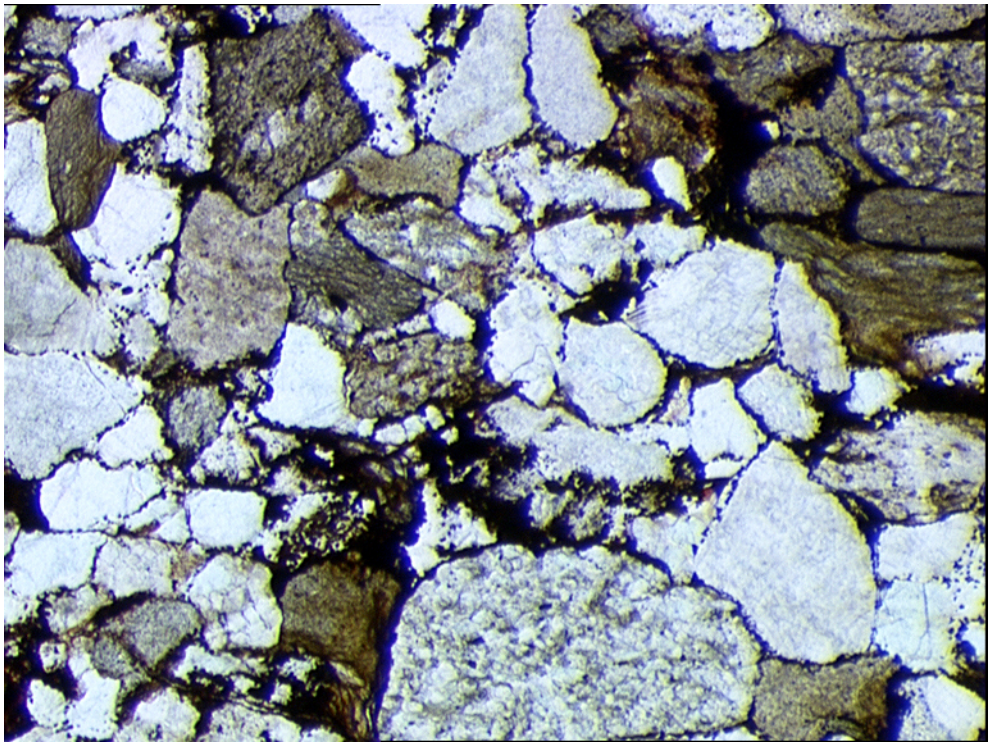
Igneous grains

A number of pebbles are heavily ferruginized volcanic, igneous rock fragments, with finely crystalline altered matrix.

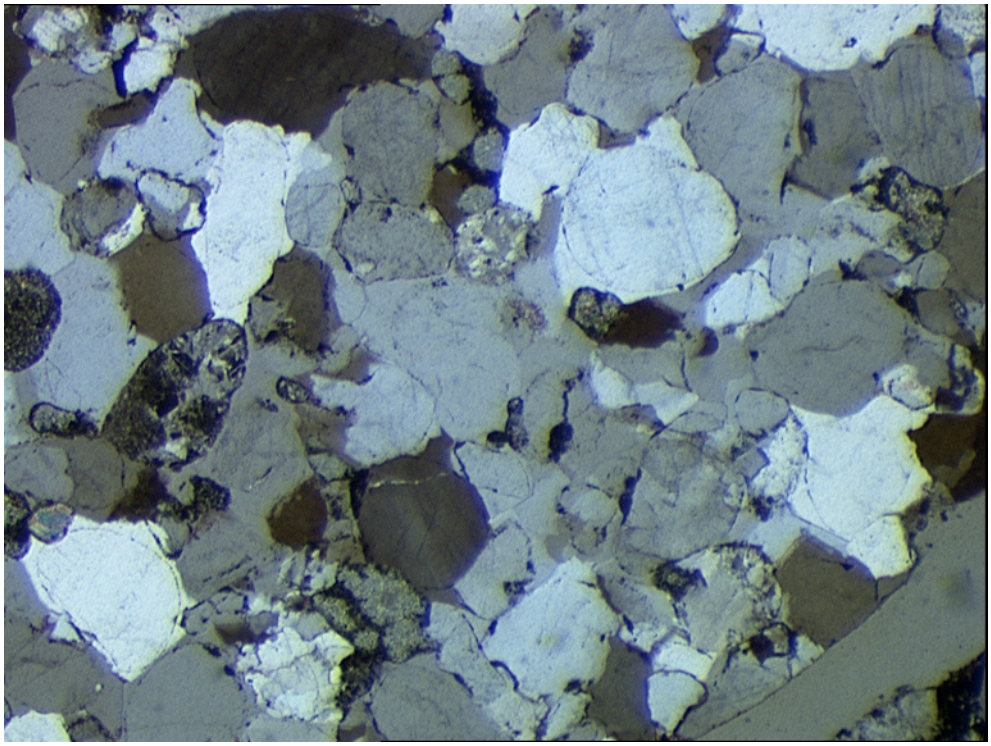
Metasedimentary

The metasedimentary pebbles are resticted to fine grained, welded quartzitic rock types.

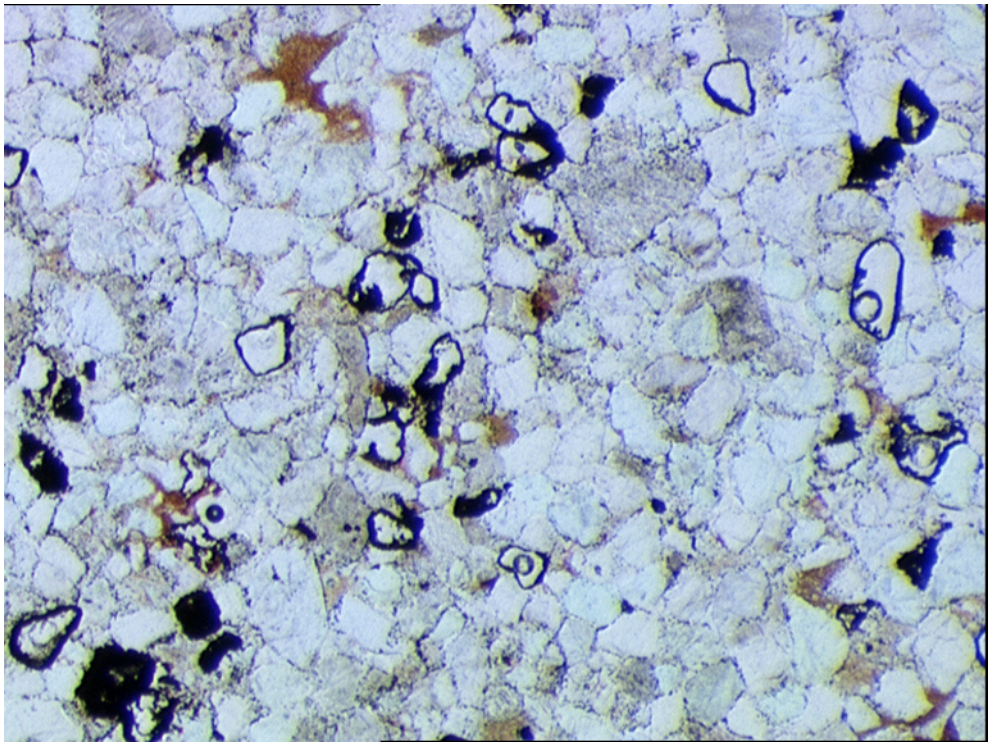

C
B
A
E
D



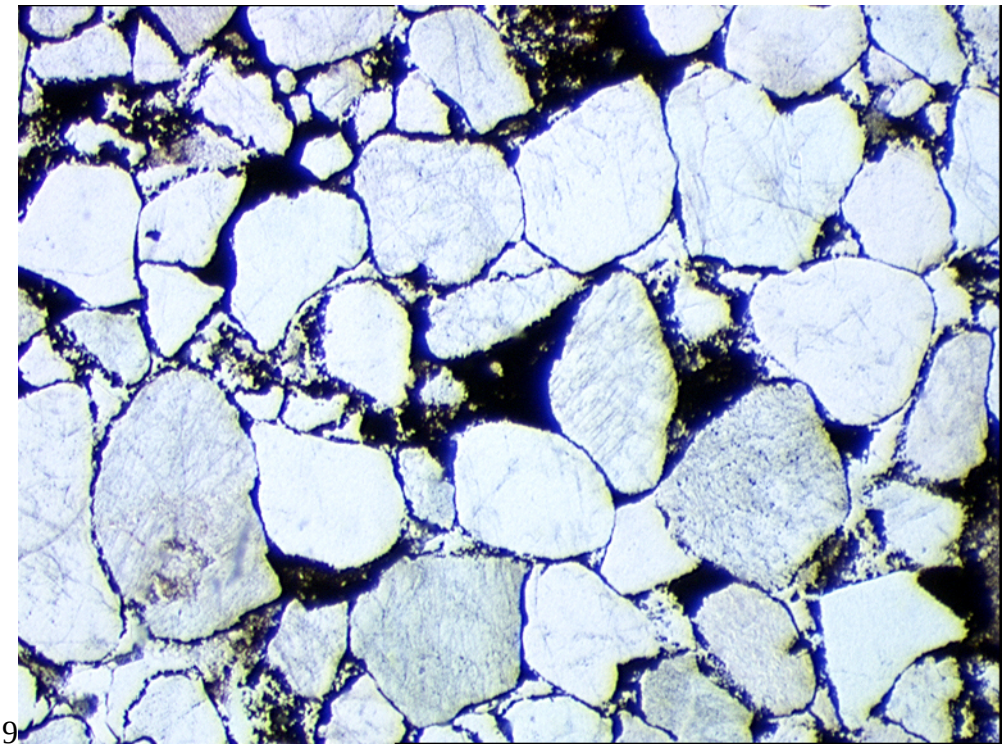
Thin section A - Pebble 5



Thin section A - Pebble 9

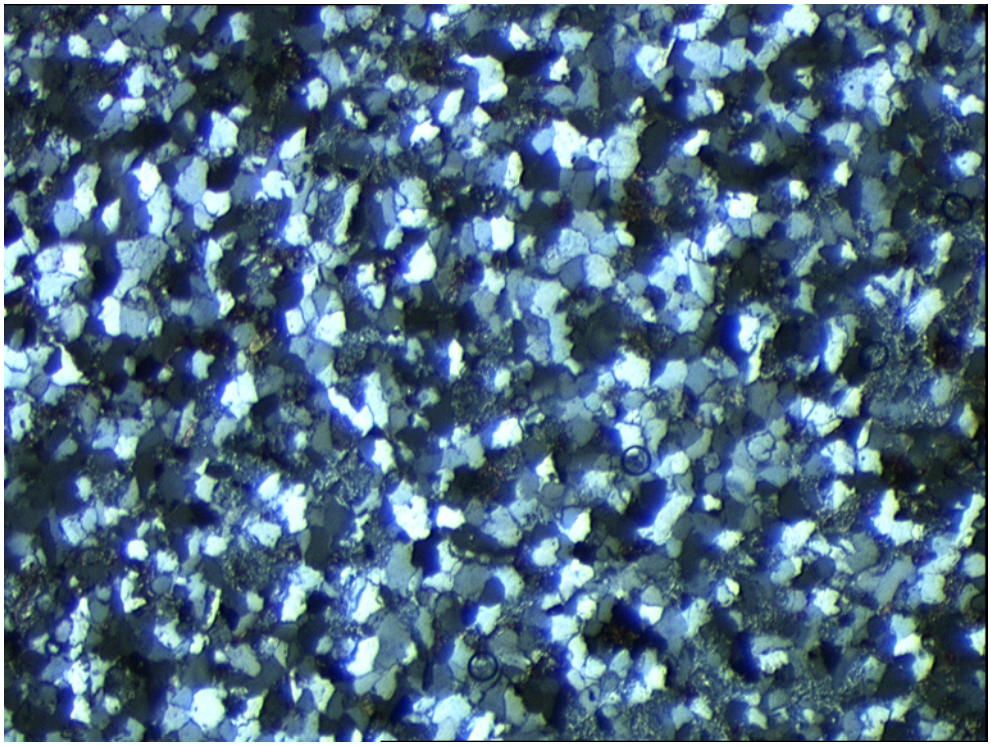


Thin section A - Pebble 11

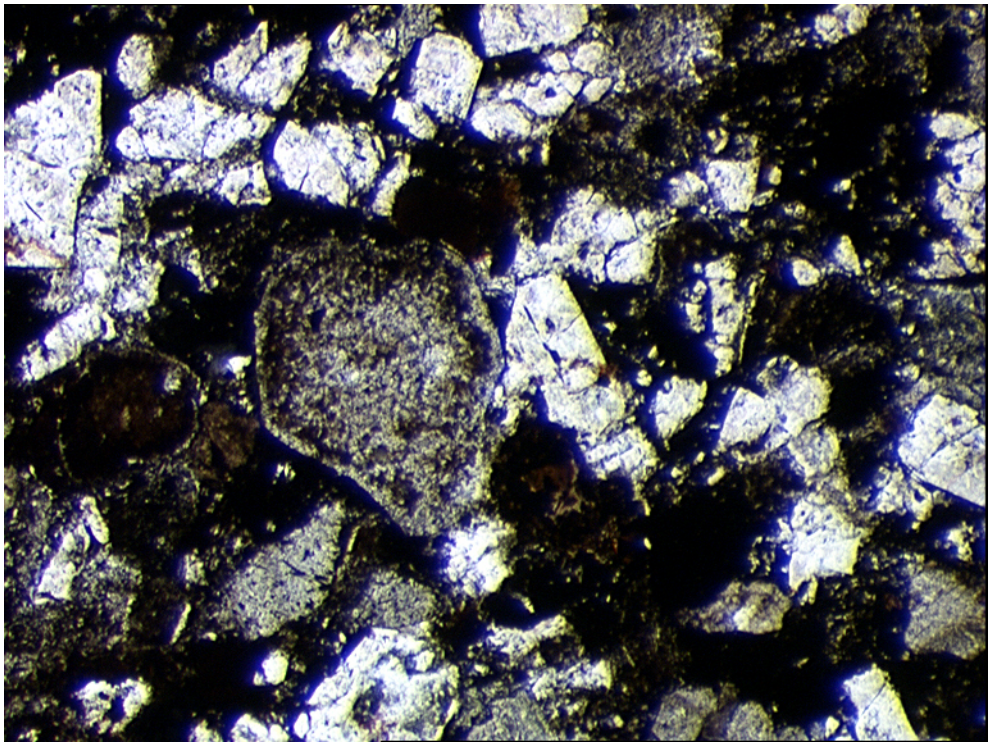


9

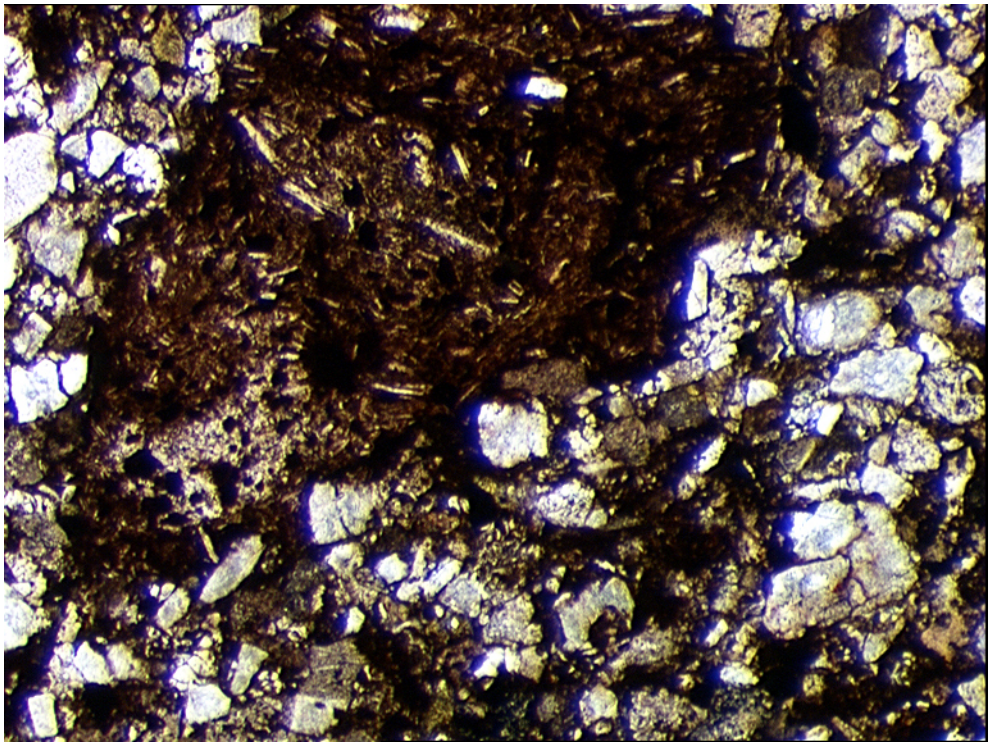
Thin section D - Pebble 6



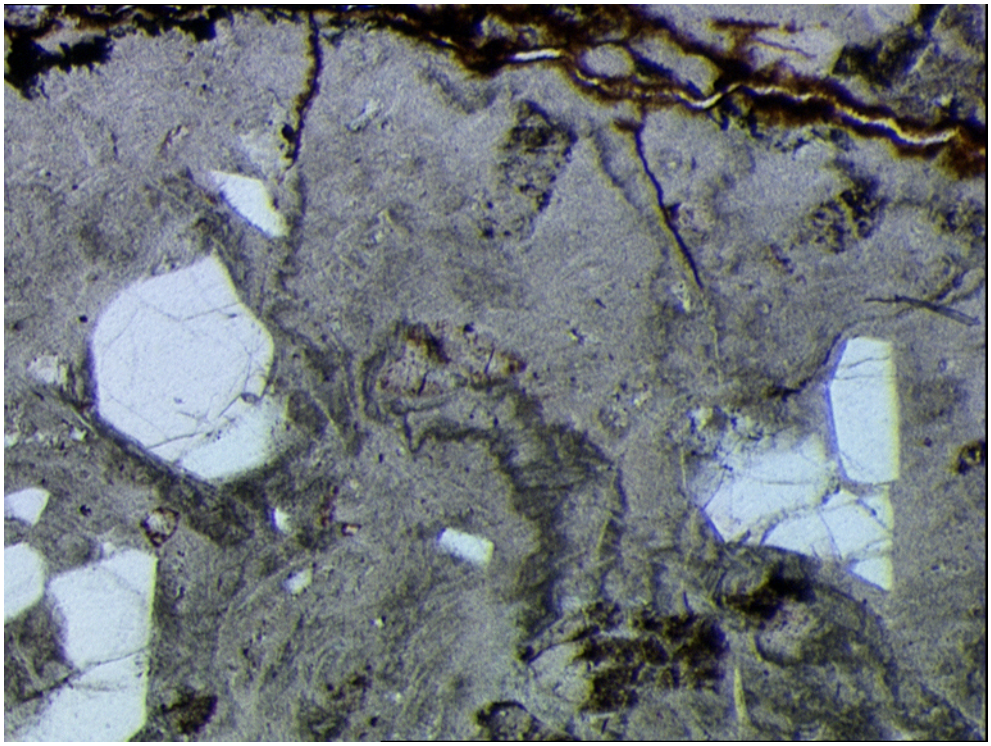
Thin section E - Pebble 2



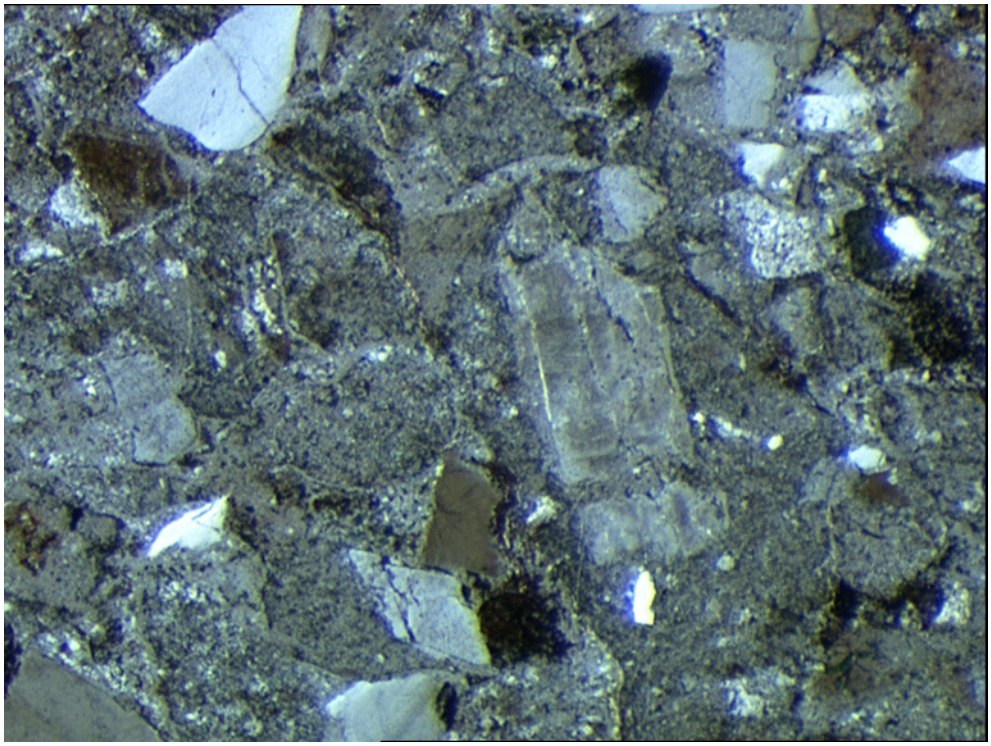
Thin section A - Pebble 1



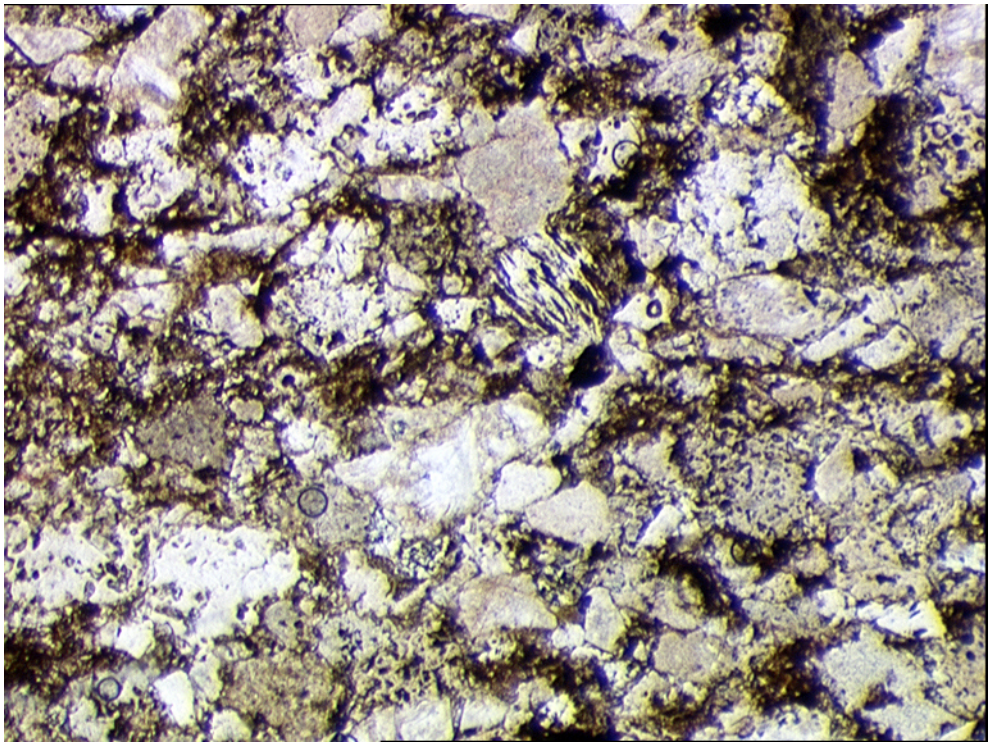
Thin section A - Pebble 3



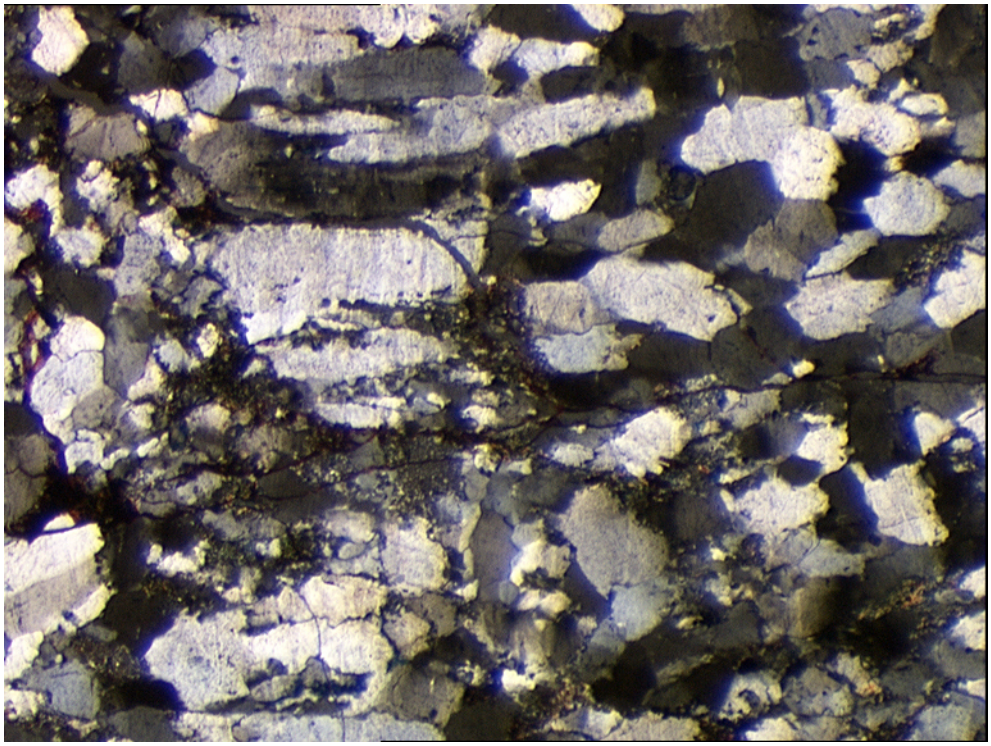
Thin section C - Pebble 4



Thin section E - Pebble 1



Thin section E - Pebble 3



Thin section D Pebble 11 - quartzite

Thin section A.

Pebble 1
Ferruginized and altered, medium-coarse grained, feldspathic, volcaniclastic sandstone.

Pebble 2
Ferruginized, fine grained, feldspathic, volcaniclastic sandstone

Pebble 3
Ferruginized, fine grained, feldspathic, volcaniclastic sandstone, with very coarse, ferruginized, basaltic crystalline and devitrified glassy grains.

Pebble 4
Laminated mudstone

Pebble 5
Coarse grained, compacted sandstone with micaceous grains squeezed and deformed between more competant framework grains. Framework mineralogy dominated by cryptocrystalline chert, micromicaeous mudstone, siltstone and strained quartz grains. All the grains have a pervasive, ferruginous, hematitic coating.

Pebble 6
Very fine sand to coarse silt grade quartzite, cross-cut by quartz veins. Framework grains dominated by quartz, with sparse mica and ferruginized clay minerals.

Pebble 7
Altered volcanic rock

Pebble 8
Very fine sand to coarse silt grade quartzite - same lithology as *Pebble 6*

Pebble 9
Coarse grained sandstone, partially silica cemented and partially carbonate cemented. Framework grains dominated by monocrystalline quartz, with sparse chert and polyminerallic rock fragments.
The most characteristic feature is the very well rounded nature of many of the grains – millet seed eolian sources.

Pebble 10
Ferruginized and altered, medium-coarse grained, feldspathic, volcaniclastic sandstone. (*as Pebble 1*) with twinned euhedral feldspars, detrital quartz grains in an altered, ferruginous matrix.

Pebble 11
Fine grained quartzose sandstone. Framework grains dominated by monocrystalline quartz with sparse mica and cherty rock fragments in a pervasive, cryptocrystalline, ?siliceous cement. Pervasive, finely disseminated opaque ferruginous coatings to all the framework grains.

A distinctive characteristic is the presence of leached secondary pore spaces (dissolution of an unstable grains, ?feldspar or igneous, has pervasively occurred) with ferruginous infills.

Pebble 12
Ferruginized and altered, very fine grained, feldspathic, micaceous, volcaniclastic.sandstone.

Thin section B
Pebble 1
Heavily ferruginized, very fine to fine sandstone.

Pebble 2 (as Pebble 9 Thin section A)
Coarse grained sandstone, pervasively silica cemented. Framework grains dominated by monocrystalline quartz, with sparse chert and polyminerallic rock fragments.
*The most characteristic feature is the very well rounded nature of many of the grains – millet seed **eolian** varieties common.*

Pebble 3 (as Pebble 11, Thin section A)
Fine grained quartzose sandstone. Framework grains dominated by monocrystalline quartz with sparse mica and cherty rock fragments in a pervasive, cryptocrystalline,?siliceous cement. Pervasive, finely disseminated opaque ferruginous coatings to all the framework grains.
A distinctive characteristic is the presence of leached secondary pore spaces (dissolution of an unstable grains, ?feldspar or igneous, has pervasively occurred) with ferruginous infills.

Pebble 4 Quartzite (as Pebble 6, Thin section A)
Very fine sand to coarse silt grade quartzite, cross-cut by quartz veins. Framework grains dominated by quartz, with sparse mica and ferruginized clay minerals.

Pebble 5
Fine to medium grained, pervasively silica cemented sandstone. Framework grains, some well rounded, dominated by monocrystalline quartz, with syntaxial silica overgrowths, sparse micromicaceous grains and patches, and rare muscovite micas.

Pebble 6
Very fine grained, weakly laminated sandstone, with ferruginized, micaceous matrix. Monocrystalline quartz grains dominate the framework. Sparse muscovite mica grains.

Pebble 7
Rounded carbonate clast, with weak ?cleavage, set in remnants of coarse carbonate cemented sandstone with well rounded grains (as in Pebble 9, Thin section A)

Pebble 8
Volcaniclastic sandstone (As Pebble 12, Thin Section A)

Pebble 9
Ferruginized, fine to medium, volcaniclastic, feldspathic sandstone, cross-cut by quartz (with occasional carbonate) veining.

Pebble 10
Heavily ferruginized, very fine to fine sandstone?
As Pebble 1

Pebble 11
Coarse grained sandstone, pervasively silica cemented.
As Pebble 2

Pebble 12
Very fine grained, altered, volcaniclastic rock, with quartz veining.

Pebble 13
Fine grained quartzose sandstone
As Pebble 3

Pebble 14
Ferruginised, fine to medium grained volcaniclastic sandstone, with a muddy, argillized matrix. Basaltic fragments common..

Pebble 15
Very fine grained, weakly laminated, argillaceous, micaceous, sandstone. Framework grains dominantly monocrystalline quartz, with abundant muscovite mica grains.

Thin section C
Pebble 1 (as Pebble 3, Thin section B)
Fine grained quartzose sandstone. Framework grains dominated by monocrystalline quartz with sparse mica and cherty rock fragments in a pervasive, cryptocrystalline, ?siliceous cement. Pervasive, finely disseminated opaque ferruginous coatings to all the framework grains.
A distinctive characteristic is the presence of leached secondary pore spaces (dissolution of an unstable grains, ?feldspar or igneous, has pervasively occurred) with ferruginous infills.

Pebble 2
Very fine grained, finely laminated, ferruginized, micromicaeous, ?volcaniclastic sandstone.

Pebble 3
Heavily ferruginized, very fine grained, finely laminated, micromicaeous, ?volcaniclastic sandstone.

Pebble 4
Devitrified igneous rock

Pebble 5

Very fine grained, ferruginized, weakly laminated, micaceous sandstone. Framework grains dominated by monocrystalline quartz, with abundant muscovite mica grains.

Pebble 6
Fine grained quartzose sandstone.
As Pebble1

Pebble 7
Ferruginized, very fine to fine grained, argillized, volcaniclastic sandstone with common devitrified volcanic glass grains. Cross-cut by?quartz veins

Pebble 8
Devitrified volcanic glass.

Pebble 9
Heavily ferrugenized, devitrified volcanic glass.

Pebble 10 (as Pebble 5, Thin section A)
Coarse grained, compacted sandstone with micaceous grains squeezed and deformed between more competant framework grains. Framework mineralogy dominated by cryptocrystalline chert, micromicaeous mudstone, siltstone and strained quartz grains. All the grains have a pervasive, ferruginous, hematitic coating.

Pebble 11
Coarse grained, ferruginized and altered (argillized), volcaniclastic sandstone.

Thin section D
Pebble 1
Heavily ferruginized fine grained, ?volcaniclastic rock.

Pebble 2
Well-sorted fine grained sandstone, with a ferruginous, argillaceous matrix. Framework grains dominantly monocrystalline quartz.

Pebble 3
Poorly sorted fine to coarse-grained sandstone. Ferruginous argillaceous matrix with patches of siliceous cement.

Pebble 4
Heavily ferruginized, very fine grained, ?volcaniclastic rock.

Pebble 5
Devitrified volcanic glass, with crosscutting fine, carbonate-filled veins.

Pebble 6
Coarse grained sandstone, pervasively silica cemented. Framework grains dominated by monocrystalline quartz (some very well rounded) with sparse chert rock fragments. Pervasive, finely disseminated, ferruginous grain coatings.

Pebble 7
Heavily ferruginized, very fine grained, ?volcaniclastic rock.

Pebble 8
Devitrified volcanic glass, with cross-cutting fine, silica-filled veins.

Pebble 9
Well-sorted fine grained sandstone, with a ferruginous, argillaceous matrix. Framework grains dominantly monocrystalline quartz, with sparse feldspar and muscovite mica.

Pebble 10
Very fine grained, ferruginized, micromicaeous, sandstone. Framework grains dominantly monocrystalline quartz with sparse feldspar and muscovite mica.

Pebble 11
Medium grained quartzite, laminar fabric, with pervasive silica cementation. Sparse squeezed micaceous grains.

Pebble 12
Fine grained, pervasively silica cemented sandstone. Framework grains dominated by monocrystalline quartz, sparse micas all with ferruginous grain coatings. Cross-cut by extensive silica-filled veins.

Pebble 13
Very fine, weakly laminated sandstone with a ferruginous, micaceous matrix. Framework dominantly monocrystalline quartz, with subordinate chert and mica grains.

Pebble 14
Altered ferruginous, volcaniclastic rock, with cross-cutting, silica-filled veins.

Pebble 15
Coarse to very coarse altered, volcaniclastic sandstone.

Thin section E
Pebble 1
Coarse to very coarse, altered, volcaniclastic sandstone.

Pebble 2
Wells sorted, very fine grain sandstone, with a pervasive argillaceous cement.

Pebble 3
Medium grained, altered, volcaniclastic sandstone

Pebble 4
Wells sorted, very fine grain sandstone, with a pervasive argillaceous cement.

Pebble 5

Wells sorted, very fine grained, ferruginous sandstone, with a pervasive argillaceous cement. Cross-cutting silica filled veins.

Pebble 6
Devitrified, ferruginized, volcanic glass.

Pebble 7
Cryptocrystalline ?volcaniclastic rock.

Pebble 8
Ferruginous siltstone

Pebble 9
Heavily ferruginized, very fine grained, ?volcaniclastic rock.

Pebble 10
Ferruginized mudstone with fine cross-cutting, silica-filled fracture

Pebble 11
Coarse to very coarse, altered (argillized), volcaniclastic sandstone

Pebble 12
Well sorted, very fine grain sandstone, with a pervasive argillaceous cement.

Pebble 13
Wells sorted, very fine grain sandstone, with a pervasive argillaceous cement. Mica grains common.