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## Urban Geology on Victoria Street, SW1

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*Ruth Siddall & Di Clements  
2013*

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This walk starts at Westminster Abbey and follows the north side of Victoria Street, SW1, as far as Westminster Cathedral and then returns along the south side of Victoria Street to Westminster Abbey. This walk may be supplemented by a visit to the astonishing collection of decorative stones used in Westminster Cathedral which are catalogued and described in Patrick Rogers's excellent book (Rogers 2008).

*The first stop is a worthwhile diversion from Victoria Street along Tothill Street. From the Sanctuary cross over Victoria Street and pass Barclay's Bank and turn left into Tothill Street. Cross over and walk up to Caxton House, the Department of Work & Pensions, on the corner of Matthew Parker Street.*

### **Caxton House**

Situated on the north side of Tothill Street, Caxton House's distinctive stonework is visible from a distance, It was designed by architects Chapman Taylor Partnership, 1979 and won a Stone Award in 1981. The foundations of the building are Cornish granite, probably from Bodmin Moor. Otherwise, the building is clad with Portland Roach which is widely used in London, but this is a special facies from that formation. The Roach is a variety of Portland Stone wherein all the



(aragonitic) shell fossils have been leached away leaving casts and moulds of the shells, typically a spiral gastropod known as the Portland Screw and the large shells of *Trigonia* species bivalves, known to the quarrymen as horses' heads (or osses' eads). However in this variety of Roach, the Portland Screws are absent and the *Trigonia* are less common and the stone is dominated by the reef-forming fossil algae. Patch reefs, 4 x 8 m occur as bioherms in the Roach. These facies were named the Winspit Member by Townsen (1975) but the name was not widely adopted. The reefs are known from most of the quarries on the Isle of Portland but are unknown from mainland outcrops. Fürsich et al. (1995) have studied them in the main quarry sites. In the reefal Roach facies,

the main framework builders are the red algae *Solenopora portlandica*, diannual layers of *Solenopora* have leached away. *Solenopora* range in size from 1 – 30 cm, 'cauliflower-like' heads. In some reefs the bryozoan *Hyporosopora portlandica* also occurs. Interstices are infilled with micritic calcite and ooids. Reef growth was initiated in lagoonal waters on the coquinas of the Roach. When patch reefs are encountered in the quarries they are slabbed and stored as matched, potential cladding stone.

The Portland Limestone Formation, which includes the building stones called the Base Bed, Whitbed and Roach, was deposited in warm, shallow seas during the Tithonian (Upper Jurassic). They are primarily quarried from the Isle of Portland, Dorset. They are London's most important building stones and they will be encountered again on this walk.

*Cross over and return to Victoria Street, stopping at the entrance to Barclays Bank on the corner of Tothill and Victoria Streets.*

### **Barclay's Bank**

Designed by N. D. N. Fairbairne and built between 1971 and 1975, Barclay's is clad with white travertine slabs, laid so that the banding is vertical. Travertines have been used as building stones since Antiquity. Despite their crumbly-looking and porous outward appearance, they are strong and hardwearing stones, as testified by buildings such as the Colosseum of Ancient Rome. The pores are usually so large that water evaporates and does not cause a problem. However many travertines employed in external buildings in wetter climates have the porosity infilled with concrete or resin, as in the stone used here. The word travertine is a corruption of 'Tiburinus' and the region of Lake Tiburtinus at Tivoli, just west of Rome is still the most important global producer of travertine. It is very likely that Tivoli is the source of the stone used here. Other important producers are Turkey and Iran and more recently Greece, Peru, Mexico have become important on the global market.

Travertines are precipitated from water at the Earth's surface. The Tivoli Travertines are produced in a geothermal environment, from a combination of volcanic-sourced carbon dioxide and/or the decarbonation of limestones by geothermal waters. These stones are banded or layered with both micrite and sparite calcite. Another common feature are delicate 'arborescent' or 'shrub' features which are micritic aggregates replacing cyanobacteria build-ups (Ángeles García-del-Cura et al.,

2012). Pisoliths, plant fossils and detrital material may also be present. These are young stones deposited in the last 100 thousand years (Facenna et al., 2008).

The steps of the bank are of a dense calcarenitic limestone, rich in finely comminuted, grey fossil fragments. Unfortunately it has not been possible to identify the source of this stone.

### **HSBC Bank & 10, Victoria Street**

These two, rather nondescript, buildings occupy the next 100 metres or so. Built by Burnet, Tait & Partners (1954-6) and described aptly by Pevsner as 'slab-type' buildings, they are faced with Portland Stone Base Bed. Part of the Portland Limestone Formation, the Base Bed is the purest limestone, an oolite with sparse fossils. Inserts of a pale green-grey, slightly iron-stained schist is used for panels above the first floor windows and the upper stories. This cannot be examined at close hand but it is very likely to be Barge Quartzite from the Piedmont of northern Italy.

### **New Scotland Yard**

Across Dean Farrar Street, we come to the anti-tank flower planters that surround London Metropolitan Police's New Scotland Yard. This building is by architect Max Gordon for Chapman Taylor Partnerships built between 1962 and 1966. Square section, engaged pillars frame the windows at pavement level. These are clad with Merrivale Granite from the Princeton area of Dartmoor. Rumour has it that 'old' Scotland Yard was built from Merrivale Granite quarried by Dartmoor prisoners, and whether or not quarried by prisoners, the same stone was used in the new building. This is a coarse grained granite, with a few, large megacrysts of white potassic (K) feldspar. The groundmass is composed of grey, translucent quartz, black biotite and white muscovite mica. White K-feldspar is also abundant in lath-shaped crystals, sometimes partially kaolinised and appearing greenish in colour. The Dartmoor Granite is 295 million years old and is part of the Cornubian Batholith that extends as far west as the Scilly Isles.

### **Christchurch Gardens**

Past New Scotland Yard and Broadway is the small square occupied by Christchurch Gardens. The monument in the gardens at the entrance from Broadway is of geological note. It is dedicated to Victims of Violence, the victims of murderers and was erected in 2012. The plaque with a relief sculpture by artist Jim Martins is carved from a dense, homogeneous grey slate, probably Delabole, which is the Devon-based artist's favourite material.



*Left: Merrivale Granite on New Scotland Yard; Right: Victims of Violence Memorial.*

The plinth is a block of rough hewn Cornish Granite which provides a rare opportunity in the urban landscape to see granite in its natural weathered state. The stone is very similar to the polished Merrivale stone seen on New Scotland Yard. The hardest mineral present, quartz, weathers proud, whilst the kaolinised K-feldspar laths have a chalky appearance. The process of kaolinisation is a form of chemical weathering which is driven by a combination of magmatic waters and ground waters. Through the interaction of the water, feldspar breaks down to form soft, crumbly, white kaolinite, better known as china clay.

On the other side of the gardens is a monument dedicated to the suffragette movement (by Edwin Russell, 1970), in the form of a bronze scroll, it stands on a plinth of Portland Stone.

*Return to Victoria Street.*

### **Windsor House, 50, Victoria Street**

A large office and retail complex, comprising three buildings occupies the adjacent block on Victoria Street. All designed by Richard Seifert and constructed between 1971-1977, Windsor House, 50 Victoria Street, fronts onto the pavement. Seifert always used stones to stunning effect. This building is clad with a brown charnockitic granite called Dakota Mahogany. On closer inspection, this is a multicolored stone pink-brown K-feldspar, bluish quartz, brown biotite and hornblende, with cherry pink smudges of hematite. On a macro scale, the rock exhibits a strong foliation, with distinctive orange streaks. This is an ancient rock, 2700 million years old from Millbank, South Dakota which has achieved great popularity as a building stone.

The stones used for interior flooring and wall cladding also extend to the pavement and the seating area outside the entrance of the building. This features a white granite, spotted with clots of brown zoisite, but with other minerals appearing fuzzy. This stone is from Bethel in Vermont, USA and is part of the suite intruded during the Acadian Orogeny, c. 380 million years ago. The other stone is a variety of 'Kashmir'. This stone is not derived from Kashmir; the name is used generically to describe garnet-bearing, pale-coloured orthogneisses. This stone is slightly greenish in colour, but the red garnet crystals are obvious, indicating an amphibolite to granulite facies metamorphic grade. A schistosity is defined by biotite and feldspar and quartz are also present, and in fact this rock is a migmatite, frozen at the point of melting. It is probably derived from Tamil Nadu in Southern India (Plavsa et al., 2012; Price 2007).



*Windsor House. Left; Dakota Mahogany granite; Right; Kashmir migmatite. Garnets are 2-5 mm diameter.*

*A short diversion, with an opportunity for refreshments can be taken down the pedestrian passage of Palmer Street, to Café Rendezvous, just behind Windsor House in the left.*

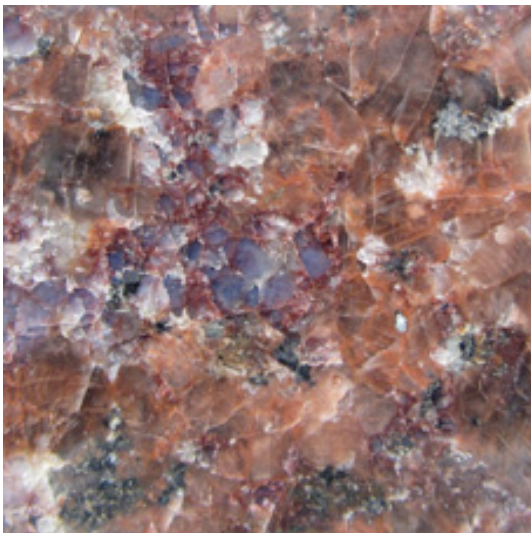
### **Rendezvous Café, Palmer Street**

In the same office and retail complex as Windsor House the exterior of the Rendezvous Café is clad with Dakota Mahogany granite. However, inside, the floor is paved with a beautiful stone called Crema Valencia from a single quarry at Barxeta in Valencia Province, Southern Spain. This is a late Cretaceous, orange-yellow limestone, flushed with pink and with irregular, stylolitic, dark-red veins, infilled with hematite. This is a well known decorative stone and it is also used in Westminster Cathedral (see Rogers, 2008 and Price, 2007).

*Return back to The Albert pub on the corner of Victoria Street and Buckingham Place.*

### **The Albert**

The Albert is the only Victorian building left standing on this side of Victoria Street, it holds its own against Seifert's Dakota Mahogany-clad towers (see frontispiece). The pub was built in 1862 by J. Carter Woods for the Artillery Brewery which once stood across the road. There is decorative yellow and red brickwork above, but the ground floor is clad with Scandinavian granites, which were very popular from the 1880s, which suggests that this decorative cladding was a later addition. The foundation levels are in a pale blue grey variety of Norwegian larvikite called Marina Pearl. A few panels have been replaced with a darker variety of this stone. Larvikite is from the Oslo area and is Norway's national stone (see Heldal et al., below). It contains equal amounts of potassic feldspar and plagioclase and no quartz, which classifies it as a monzonite. The most distinctive mineral is the plagioclase variety oligoclase which shows the play of blue colours known as 'schiller'. Though geologically unrelated, the larvikite intrusions are the same age as the Cornish granites, they were emplaced at ~295 Ma in the early Permian.



Above the larvikite, faceted, engaged pillars are clad with a dark red, very coarse grained granite. The large red crystals are K-feldspar, black biotite is also present. What is interesting about this rock are the violet quartz crystals. However, these are not amethysts; their colour is an optical illusion brought about by a combination of the quartz being deformed and strained plus staining around grain boundaries by cherry-red hematite (iron oxide). This is one of the 'coastal red' granites from the Kalmar region of Sweden associated with the Svecofennian Småland Granites with were intruded around 1700 million years ago.

*Left; red granite with violet, strained quartz.*

*Across Buckingham Gate, lies a metal and glass-built structure of attractive design, including a green wall, but of little of geological interest. Continue past this to Westminster City Hall.*

### **Westminster City Hall**

Westminster City Hall is a 19-storey slab-type building by Burnet Tait & Partners (1961-6). The exterior is dominated by glass, but a low wall (outside Waitrose) and a slab supporting the city arms are made of a black igneous rock which is probably Nero Absolute Zimbabwe. This is a

dolerite, containing augite clinopyroxene, hornblende, feldspar and magnetite. The latter mineral is largely responsible for the black colour. This stone is from Mashonaland, western Zimbabwe and is from a series of 1870 million year old intrusions.

Access to the foyer of Westminster City Hall is possible. It is worth looking inside as the foyer is clad with impressive, quarter-matched marble. This is a grey and white, streaked marble. Its provenance is not known but it is most likely Italian but it could also be Greek or Turkish. Similarly the floor is white marble, probably from the Carrara region of Italy.



*The foyer of Westminster City Hall.*

*Beyond Westminster City Hall, at the time of writing, the next block (formerly Esso House, where my Dad worked in the 1960s!) is undergoing construction and surrounded by hoardings. Continue to the end of the block and cross over Palace Street and then use the crossing to cross Victoria Street to Cathedral Plaza in front of John Francis Bentley's Neo-Byzantine Westminster Cathedral (1895 - 1903).*

### **Cathedral Piazza**

Westminster Cathedral's exterior is built of red Bracknell Brick with stripes of Portland Stone, sitting on foundations of Cornish Penryn Granite (Bradley & Pevsner, 2005). Bentley contracted Farmer & Brindley to supply the decoration for the interior. The astonishing selection of stones inside are described by Rogers (2008) and the interested reader is referred to this book (available in the Cathedral shop) for further information.

The Piazza in front of the Cathedral is paved with a York Stone from the southern Pennines and the bollards in front of the entrance are of Rosso Verona (Rosso Ammonitico Veronese) from the Trento Plateau of the Southern Alps.

### **Ashdown House: Cathedral Piazza to Wilcox Place**

The long block of offices with retail space at pavement level, which extends from the Cathedral Piazza to Wilcox Plaza is by Elson, Pack & Roberts (1971-75). It. Like New Scotland Yard, is clad in Merrivale Granite, except for a couple of shops between 123 Victoria Street and Boots which are clad with a grey granite of unknown origin. Outside 123 Victoria Street a small wall extends onto the pavement. It is a good example of 'elephant' concrete; the wall has been cast from wooden formwork and the wood grain is visible, cast on the concrete.

### **Wilcox Place**

Only a few years ago, Wilcox Place used to be a rather dingy side street. However it has now been transformed by architects Burns + Nice into a very pleasant pedestrianized area. The small square has been paved with a 'carpet' of granite setts, surrounded by a border of grey granite. All four stones are from SE China, from the provinces of Guangdong and Fujian.

The most striking stone here, with black and white streaks, is an augen gneiss called Zebra White (or G4418), is from Xinyi in western Guangdong Province, in the Yunkai Dashan Mountains (Chen Bin & Huang Fusheng, 1995). This region is a Palaeozoic terrane formed during a mountain building event that occurred ~ 480 million years ago. 'Augen' means 'eyes' in German and refers to the eye-shaped white aggregates of crystals. There is a strong foliation to this rock, defined both by the augen and black biotite which forms the schistosity. If we were able to see this rock in three dimensions, we would see that the augen have a shape resembling slightly flattened cigars, and these are also aligned forming a 'lineation'. Such rocks, which structural geologists call L-S tectonites (because they have a Lineation and a Schistosity) are formed in rocks metamorphosed deep in the Earth's crust which are simultaneously undergoing deformation.



*Paving stones in Wilcox Place. Left to right; Black Pearl Granite, Zebra White and Grey Granite.*

The other three rocks are all igneous and come from Fujian Province. This region is composed of a series of small tectonic plates ('terranes') which were accreted to the Chinese continental margin during the Jurassic and Cretaceous periods. The geology here is dominated by the products of ancient volcanoes which were active during this period and include a voluminous series of volcanic rocks including lavas and pyroclastic flows and associated granites which represent frozen magma chambers (see Cui et al., 2013).

The darkest coloured rock here is a basalt which is derived from the volcanic series. Marketed under the name Black Pearl, it is derived from huge, columnar-jointed lava flows, resembling the Giant's Causeway of Northern Ireland, which are located near the city of Fuding on the northern

border of Fujian Province<sup>1</sup>. The lavas are about 140 million years old and were erupted during the Cretaceous Period.

The other two rocks used in this pavement are granites. The mid grey granite on the 'carpet' is a granodiorite containing the white feldspar plagioclase, black hornblendes and a small amount of greyish quartz. In contrast the border of the 'carpet' area is a pale 'Silver Grey' granite which forms the border. These are both from Cretaceous granites which outcrop in a NE trending band between the cities of Changle and Dongshan on the SE China coast, north of Hong Kong. The mid grey granodiorite is from near Changle in the north, whereas the pale grey granite is probably from the central or southern part of this belt.

### **House of Fraser**

Beyond Wilcox place stands the House of Fraser department store (formerly the Army & Navy Store). This building, also by Elsom, Pack & Roberts (1971-7), occupies the entire block up to Artillery Row. The building is faced with Tivoli travertine as at Barclay's Bank (above). The contrasting brown granite at the foundations is another familiar stone, Dakota Mahogany, as seen at 50, Victoria Street.

### **77-93, Victoria Street**

We now encounter a short stretch of older buildings. On the corner of Artillery Row and Victoria street, 77-93 is by Bassett Keeling (1895) and houses banks and cafés. It is built of red brick but ground floor is clad with pink Peterhead Granite from Stirlinghill, Aberdeenshire. 406 million years old, it is composed of pale pink feldspars with particularly glassy translucent, grey quartz and prominent black hornblende. Quartz may be associated with blood-red hematite coating grains and penetrating fractures. It contains rounded enclaves of microdiorite from 1- 5 cm diameter and also grey-black, angular, xenoliths. Peterhead Granite became an extremely popular stone in London after the coming of the railways along the east coast and the quarries remained active until the 1950s.

### **Artillery Mansions**

The next building, Artillery Mansions (John Calder, 1895), with an impressive through-storey entrance arch, is also red brick with granite details including impressive, monolithic columns flanking the arch. This time it is a grey granite with an oatmeal texture. Brownish-coloured feldspars indicate incipient kaolinisation. Its origin is unknown although it is likely to be Cornish and possibly from the St Austell area.

### **71, Victoria Street**

By the 1980s, the architecture firm of Elson Pack & Roberts had changed its name to EPR Partnership, however they still contributed to the buildings of Victoria Street. The building with the impressive entrance at 71, Victoria Street was built in the post-modern style in 1987-8. Primarily built of Portland Stone Whitbed, with trim of Portland Roach on the corner of Strutton Ground, by far and away the most geological interesting part of this building are the columns, foundations and trimmings of a spectacular grey orthogneiss. The origin of this stone is probably China, a variety known as China Juparana. It is unusual in that it is predominantly black and white, composed of white feldspars and quartz with black biotite and hornblende. There is clear segregation between the black and white minerals and the stone shows folding and deformation associated with ductile flow.

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<sup>1</sup> Images of the quarry can be found here: <http://www.stonecontact.com/quarries-1734/g684-black-pearl>





71, Victoria Street, right; details of the gneissic banding on the columns.

### 55-57, Victoria Street

Across Strutton Ground is Boston House by Covell Matthews Wheatley Partnership (1983-88), with square-section columns supporting an arcade. Currently housing the National Westminster Bank, the building, including the columns, is clad in a pretty pink granite. It is medium grained, composed of rose pink K-feldspar, transparent, clear, but fractured quartz and black biotite. It very much resembles the early Permian Porriño granite, quarried on the Spanish Portuguese border near Pontevedra. Rosa Porriño (or Porrinho, depending on your language choice) normally has brown, smoky quartz, but this may be a variety from this large intrusion.



Boston House, right; detail of the pink granite.

### 27-25, Victoria Street

Built between 1994-96 by Rolfe Judd Planning, this block housing office and retail space is built of Portland Stone Whitbed. At pavement level the 'skirtings' are of a green gneiss called Verde Maritaca (also Verde Candeias) from Minas Gerais province, Brazil. Clocking in at 3300 million years, this just beats the Dakota Mahogany in being the oldest stone used on Victoria Street. Geologically this unit is known as the Candeias Gneiss and comes from the Campo Belo Metamorphic complex, which has supplied other well known building stones including Kinawa and

Rosa Torricoda. It has undergone a series of complex deformation events, with peak metamorphism occurring 2750 Ma (Oliveira & Carneiro, 2001).

### **Department of Business, Innovation and Skills (BIS)**

Another slab building, but of great geological interest is the BIS building by Ronald Fielding (1959-1964). It is faced with two stones. The black stone forming the foundations and trim around windows has not weathered well and is therefore difficult to identify. It is probably Nero Zimbabwe. Of much greater interest is the white stone. It is of medium grain size and composed of white plagioclase feldspar, fine grained, translucent quartz and flecks of black biotite mica, which define a strong foliation. The presence of quartz usually defines a granite, but the presence of plagioclase and the absence of K-feldspar characterises a much more unusual rock. This is a rare rock type from northern Norway called trondhjemite which is marketed as Støren Granite or Polar Silver. The main quarries, worked since the 1950s, are near Follstad and this is the global type area for trondhjemites, the rock is named after the city of Trondheim (Heldal & Neeb, 2000; Dunning & Grenne, 2000).



*Department of Business, Innovation and Skills clad with white Støren trondhjemite, right.*

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