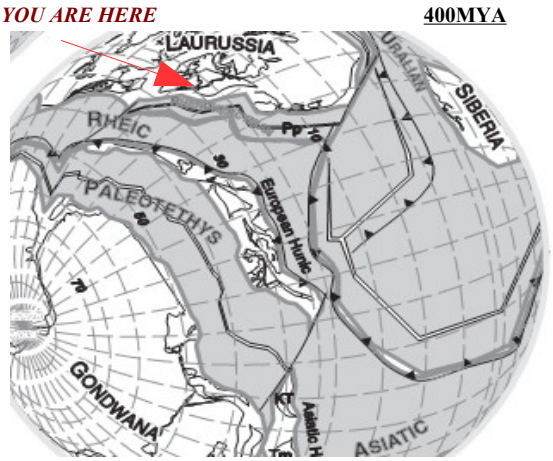
The Ground at Churchtown Farm A Geological History

The ground at Churchtown Farm formed far away to the south east in the southern hemisphere during the Devonian Period some 380 million years ago (mya). The rock was laid down on the sea bed as sand and mud that accumulated in a fault-bounded trough south of Avalonia where the Rheic Ocean lapped the coast of Laurussia, the Old Red Sandstone continent. This trough, the South Devon Basin, rifted and subsided as it filled with sediment from the landmass to the north. Magma pushed up along fractures to form dykes, or out into layers of sediment to form sills and if it reached the sea bed, submarine volcanoes. In shallower water at the edges of the basin, coral reefs formed and limestone reef debris interbedded with terrestrial and volcanic sediments.



Meanwhile on the south side of the Rheic Ocean Amorica broke from Gondwanna and drifted north closing the ocean. Amorica, and then Gondwanna, collided with Laurussia causing the sediments of the South Devon Basin to undergo 70% NW-SE crustal shortening as they were bulldozed into a series of inverted and broken folds and piled 3 – 4 km. high as the Variscan Mountains. By 290 mya granite was emplaced in the roots of these mountains and they formed part of the Central Pangean Mountain Chain reaching from Poland to Portugal across the deserts of the newly assembled supercontinent, Pangea.

For the next 100 million years during the Permian and Triassic Ages, the sedimentary rocks weathered and mountain erosion fed torrents of debris down to red desert fans and mud flats as the granite heart of the mountains was unroofed. At this time conglomerate and lava were deposited at Kingsand. Cornwall then became an island as Pangea started to break up and the warm Jurassic and Cretaceous Tethys Ocean rose over the low ground, planing it flat and depositing chalk. By 60 mya the Atlantic had started to open as Europe drifted north of the equator out of the tropics, the sea retreated and in Cornwall the chalk was dissolved away by rainwater leaving a deeply weathered tropical etch plain with granite plateaus rising from it. The tilted and uplifted remnants of this subdued relief formed the sub-horizontal erosion surfaces now echoed in consistent summit levels throughout Cornwall and illustrated here by the 120 mOD skyline that skips across the Sound from Rame to Staddon Heights.

Further uplift, 6 mya, rejuvenated rivers promoting down cutting into the weathered rock profile as the valleys we know today were established. The Tamar and Lynher washed sand and clay out to the the Mid-channel River and on to the Western Approaches Basin as the hills and ridges of Churchtown Farm were sculpted from the land. During the ice ages of the last 2 million years sea levels fell up to 120 m below present day and the rivers cut deep valleys while sea levels 8m higher than today during the warmer interglacial periods left raised beaches. Glaciation did not quite reach Cornwall but periglacial, freeze-thaw tundra conditions broke-up the land surface which crept and flowed down slope, sloughing away many raised beaches and forming jumbled head deposits at the coast.

Currently the deep valleys are filled with mud and sand, 20 m thick in the Lynher and 40 m in the Tamar while the head deposits form low cliffs at the back of beaches and rock platforms. The rolling ridges and valleys of Churchtown Farm have been smoothed by freeze and thaw, cut and filled for railway lines and dug out for quarries. Now, high tides nibble at the superficial head and weathered profile while the most active geomorphological processes are footpath erosion and digging for worms in the dock dung deposits at Sandacre Bay.

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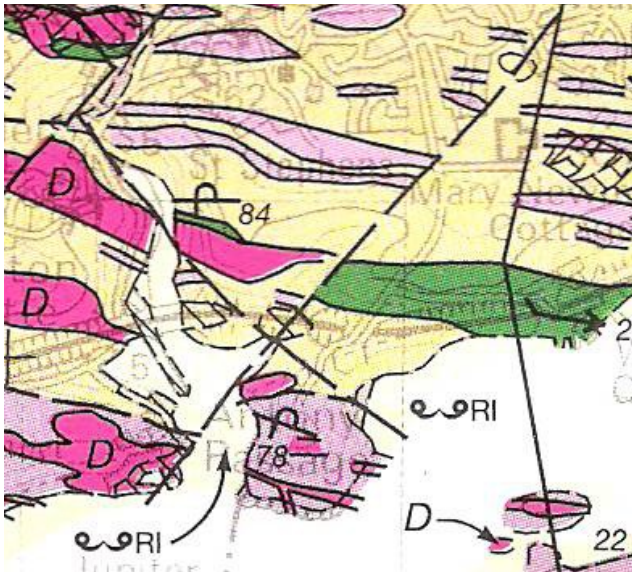

Slt Saltash Formation
Marine grey Slatey mudstones and Siltstones

WrG Wearde Grit
Fine to coarse grained sandstone

Tpt Torpoint Formation
Purple and Green (marine?) Slates. Slatey mudstones and fine grained siltstones

B Basalt (incl. some Pillow Basalt)
HaB Hyaloclastic Basalt

D Dolerite

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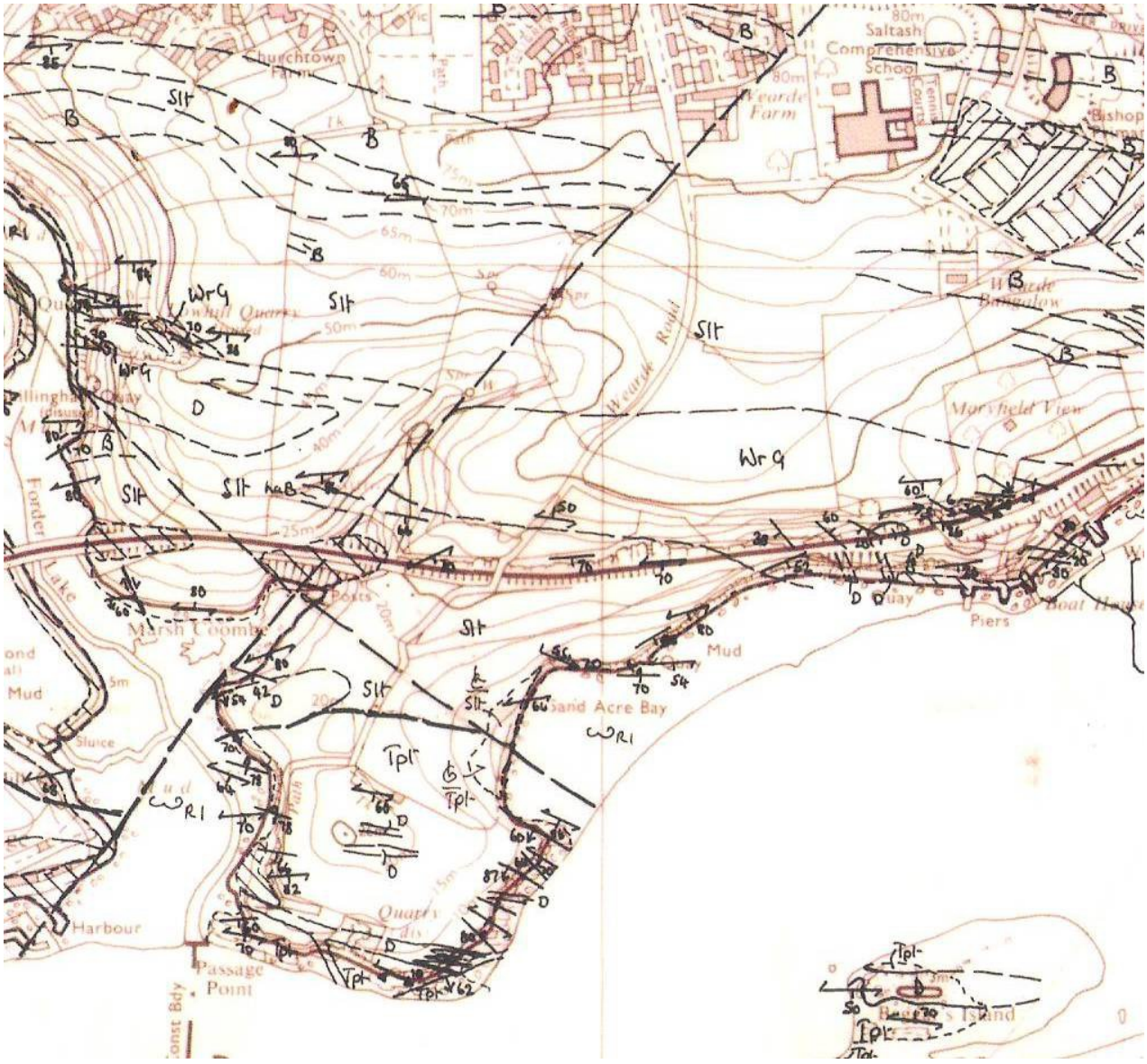

The Sedimentary Rocks at Church Town Farm are all part of the Middle to Upper Devonian Tamar Group, say 390 to 360 mya. They were deposited in the half graben South Devon Basin formed in extension (ocean island basalts) and are divided into the Middle to upper Devonian Saltash Formation mainly grey mudstones and siltstones with subordinate basaltic lavas and hyaloclastites deposited in an open marine or outer shelf environment interfingered with the land derived upper Devonian Torpoint Formation of purple and green slates possibly deposited by flows from the east in say 500 to 1000 m water depth. ("rather unexciting mudrocks" C. Bristow)

Tamar Group of Middle/Upper Devonian 387 to 360 mya

Saltash Formation, Middle and Upper Devonian say 390 to 360 mya

Marine grey Slatey mudstones and Siltstones some with laminae disturbed by bioturbation , some subordinate sandstones, volcanics and limestones. Deposited in open marine or outer shelf environment.

At Saltash/CTF the Saltash Division (377 to 363 mya)Slatey mudstone, silty mudstone and fine grained siltstone , grey and dark grey, locally interbedded and interlaminated. Sporadic laminae and thin beds of sandstone, calcareous siltstone, and bioclastic limestone. Bio turbated in parts.

Interbedded Basaltic lava flows, some with pillowed tops, now mostly folliated
Possibly present, Basaltic lava passing into massive and bedded hyaloclastite (as at Celtic Cross Site) and/or tuff. Fine breccia comprising volcanic and sedimentary rock clasts.

Wearde Sandstone Member. Fine to coarse grained sandstone in thin to thick (c 1.0) beds locally amalgamated or separated by partings or thin beds of grey slatey mudstone. Sandstone beds display plane and cross lamination , normal grading and erosive bases. Mainly deposited from turbidity currents. Maximum thickness a few tens of metres but may seem thicker due to repetition due to folding. Possible deposition of sandstones from turbidity currents channeled between contemporaneous volcanic piles.

At Wearde Quay. Sandstone Beds with thin interbeds of laminated grey siltstones . Sandstone is medium to coarse grained and shows cross lamination channeling and grading. Northward verging symmetrical D1 folds form the core zone of a larger scale antiform.

Torpoint Formation,, Plymouth Division group, Upper Devonian say 377 to 363 mya.
CTF youngs N wards (S of Lyner youngs S ward) and Ostracods give age 375 tp 365mya

Purple and Green (marine?) Slates. Slatey mudstones and fine grained siltstones
Interdigitates with Saltash Formation. Deposition from distal turbidites in open marine or outer shelf environment. in say 500 to 1000 m water depth. Red dies out to the west may indicate deposition from the east.

Red colouration and chemical composition (andesitic/basaltic) indicate continental derived oxidised sediments (ferric iron, Fe3+) . Green may be dilution of red sediment (by oceanic grey) and/or reduction to ferrous iron (FE2+) from oxidation of organic matter in diagenesis.

At Shillingham Point.Purple and grey green slatey mudstone with thin beds of siltstone and fine sandstone interbedded with grey cleaved laminated silty mudstone (At Skinham. local breccia)

Igneous rock

Basalt contemporaneous Saltash Formation typically groundmass of plagioclase laths (now albite) sphene, interstitial chloride with carbonate and sparse phenocrysts of zoned plagioclase. (up to 4mm) Ocean Island type basalt indicates crustal extension.

Dolerite Probably feeders for basalts. Olivine and Horneblende Dolerite. (horneblende, pyroxene (augite), olivine biotite, apatite, feldspar ground mass) possible picrites (fine grained olivine, augite, small feldspar)/peridotites (coarse grained olivine, pyroxene).

Structure

NW - SE Plymouth Cambreak strike slip fault zone active in the Lower Carboniferous Variscan Orogeny, collision between Amorica and the Normania Nappe/High with the Southern margin of the ORS Continent , uplift to the west

Variscan Orogeny, wave of deformation from the south causing compression, inversion and upthrusting to give thin tectonic sheets superimposed on each other in chaotic manner , then sliced by high angle thrust faults and further sliced by NW SE strike slip faults

SW - NE fault up Marsh Combe Valley

Geomorphology

Check high point elevation (75mOD) vs Edgcombe/Staddon Hts (110m OD)
Pliocene (2 mya) High Sea Level + 45m (from St Erth)
Solifluction overturning of weathered slates, aligned clasts in Head.
Honeycomb weathering pits from salt erosion

Trematon Castle, Walls Sandstone/Slate, Dolerite, Basalt. Dressed blocks(frames/lintels) hyaloclastite

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