

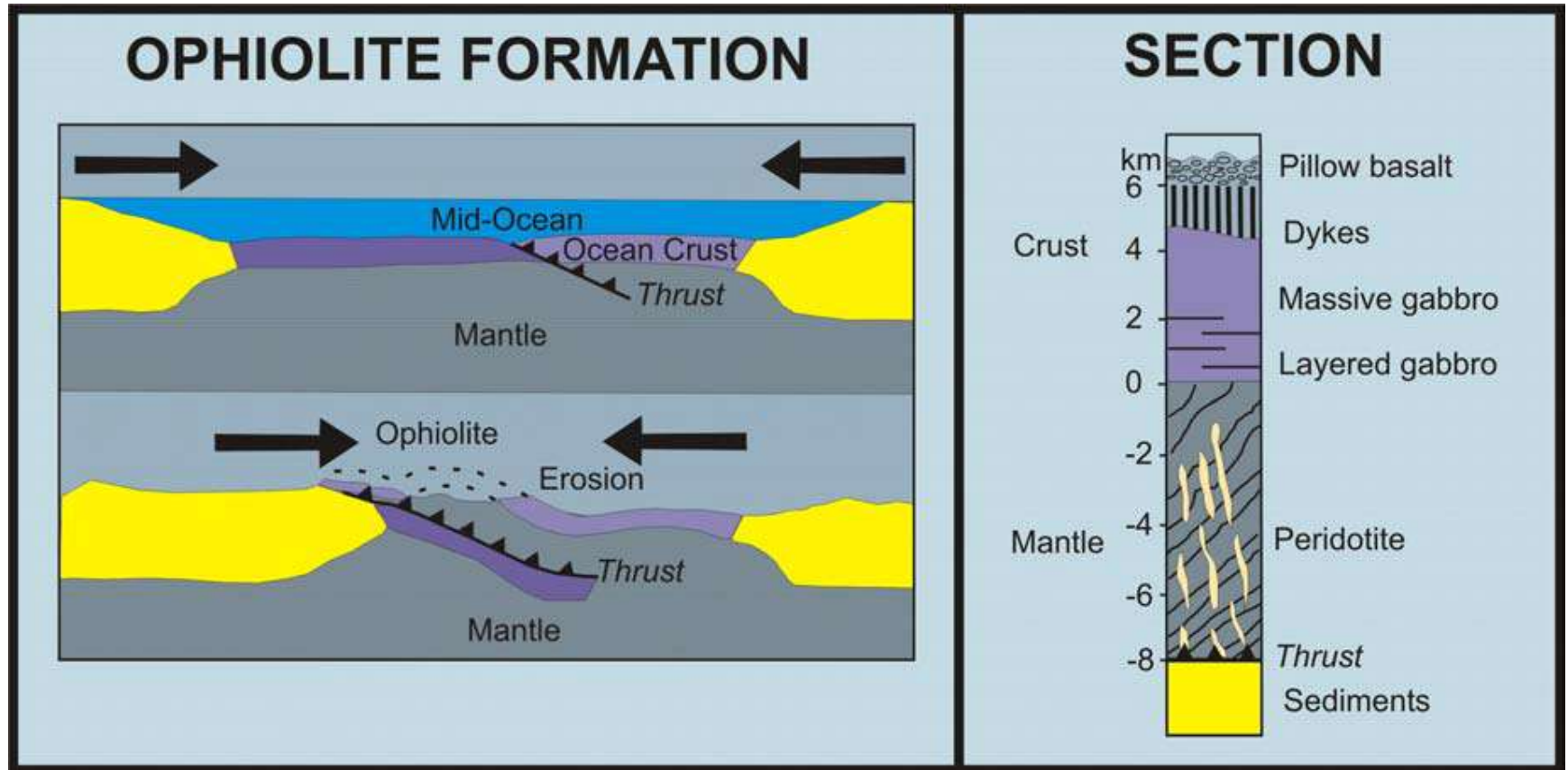
Malvern U3A Geology Group

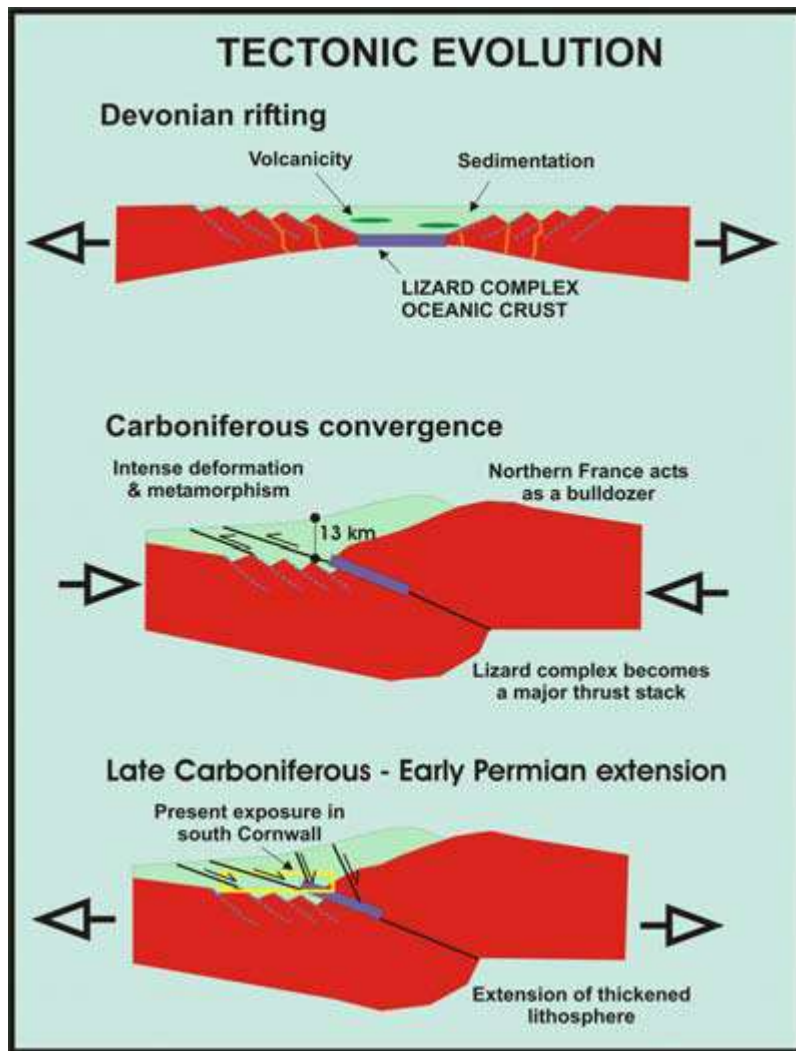
LIZARD FIELD TRIP

Led by Dr Nick Chidlaw

11th to 14th April 2013

The origin of the Lizard Complex



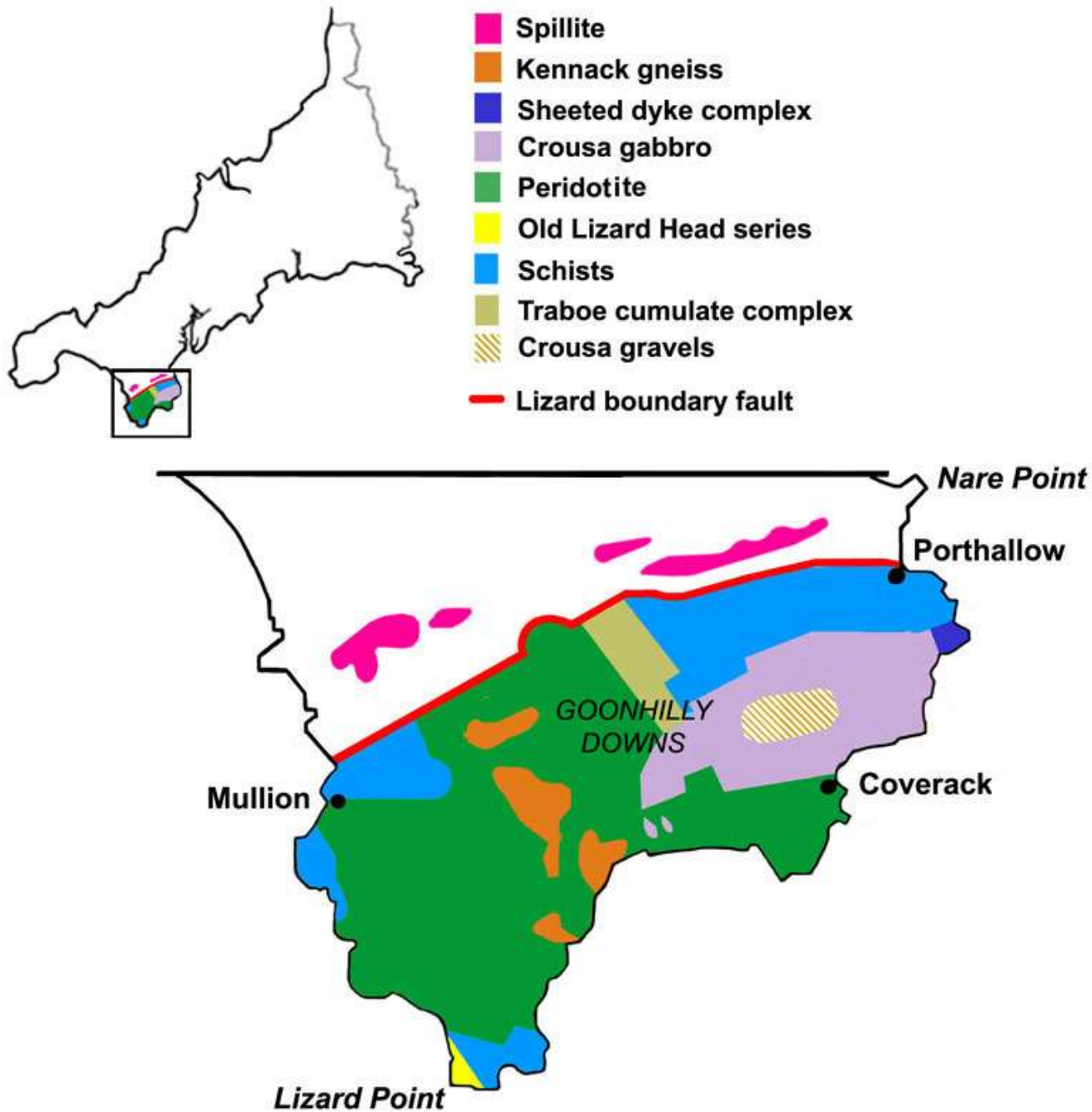


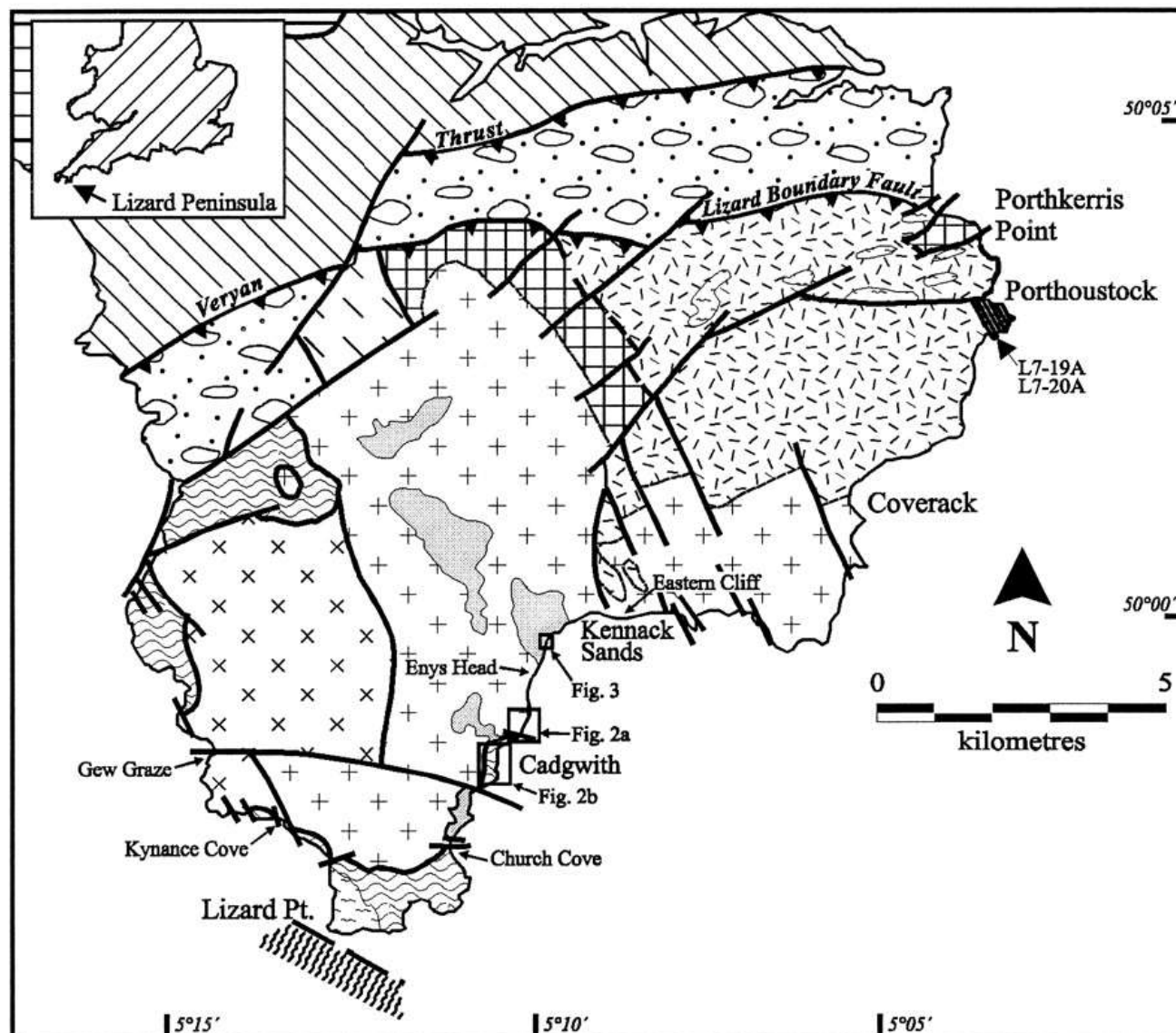
The Lizard consists of oceanic components that have been thrust faulted (obducted) over younger rocks. The context would have been a small rift basin similar to the Red Sea or Gulf of California and was formed at the same time as the development of the SW England passive margin during the Early Devonian.

This was terminated by the onset of convergence between two plates with partial 'obduction' achieved by the Upper Devonian.

The Lizard now contains a suite of rocks from the upper surface consisting of sediments, and below them pillow lavas, sheeted dykes and gabbros merging into layered gabbro followed by ultrabasic rocks of peridotite representing the crust down to, and including, the mantle.

Such sequences of rocks are known as an ophiolite complex and the Lizard is one of the best examples in Britain.



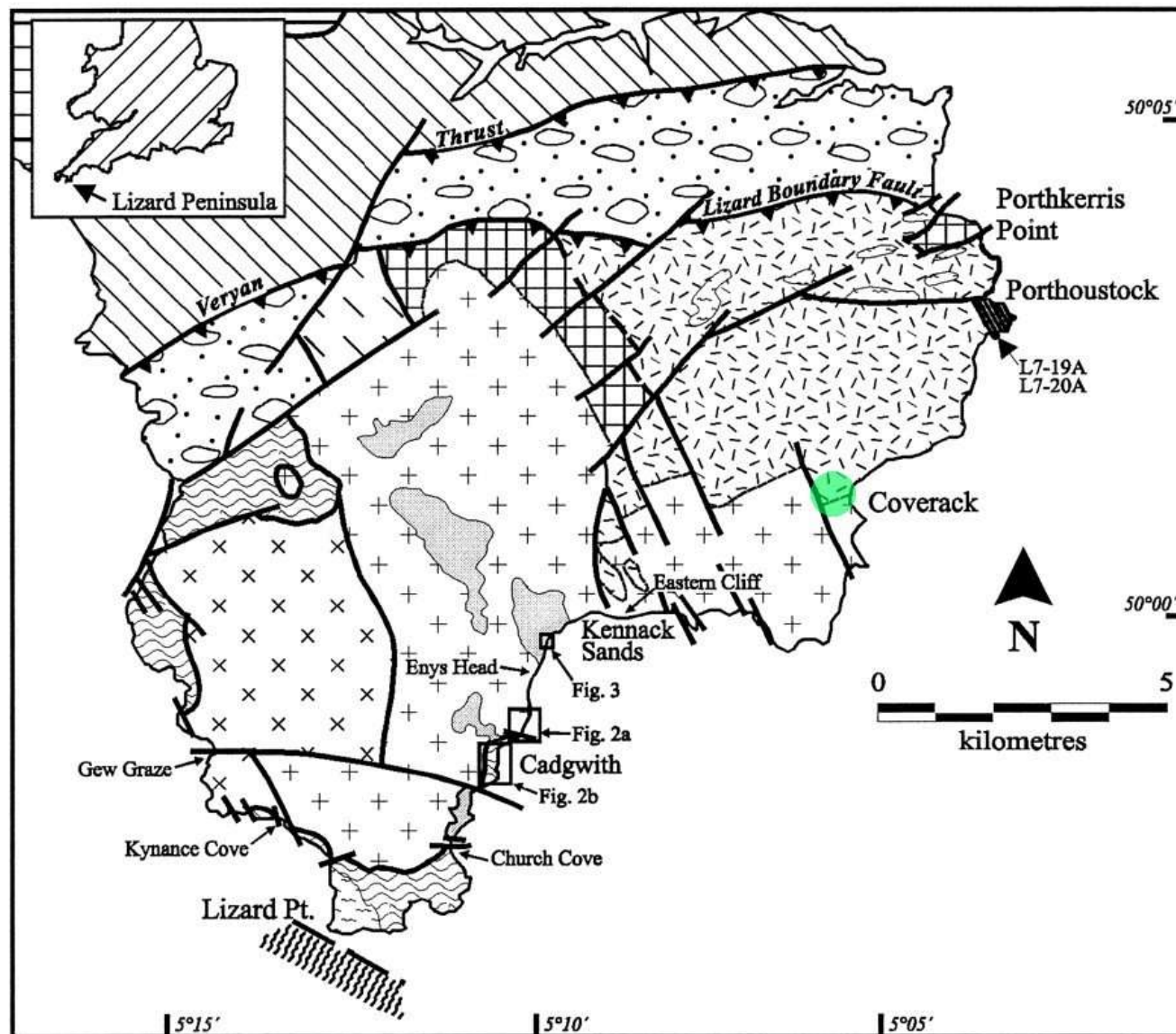


-  Meneage Formation
-  Mylor Slate Formation
-  Portscatho Formation
- Lizard Ophiolite Complex**
-  'Primary' peridotite
-  Recrystallized peridotite
-  Traboe Cumulate Complex
-  Crousa and Trelan Gabbros
-  Sheeted dyke complex
-  Lower Hornblende Schists
-  Upper Hornblende Schists
-  Old Lizard Head Series
-  Kennack Gneiss
- Tremadocian Arc Fragment**
-  Man of War Gneiss
-  thrust
-  fault (undiff.)

Coverack

Dolor Point

Friday, 12th April AM



Coverack

- A Walk across the MOHO (Mantle to Crust)
 - Bastite Peridotite – Early Devonian
 - Troctolite
 - Dunite Peridotite
 - Gabbro Pegmatite veins
 - Flaser Gabbro
 - Gabbro with Dolerite dykes

COVERACK



Dolor Point



Beach



Weathered [Peridotite](#)



Fresh [Peridotite](#)

COVERACK



Bastite Peridotite



Basalt Dyke Intrusion



Flaser Gabbro (Stretched)



Troctolyte

COVERACK



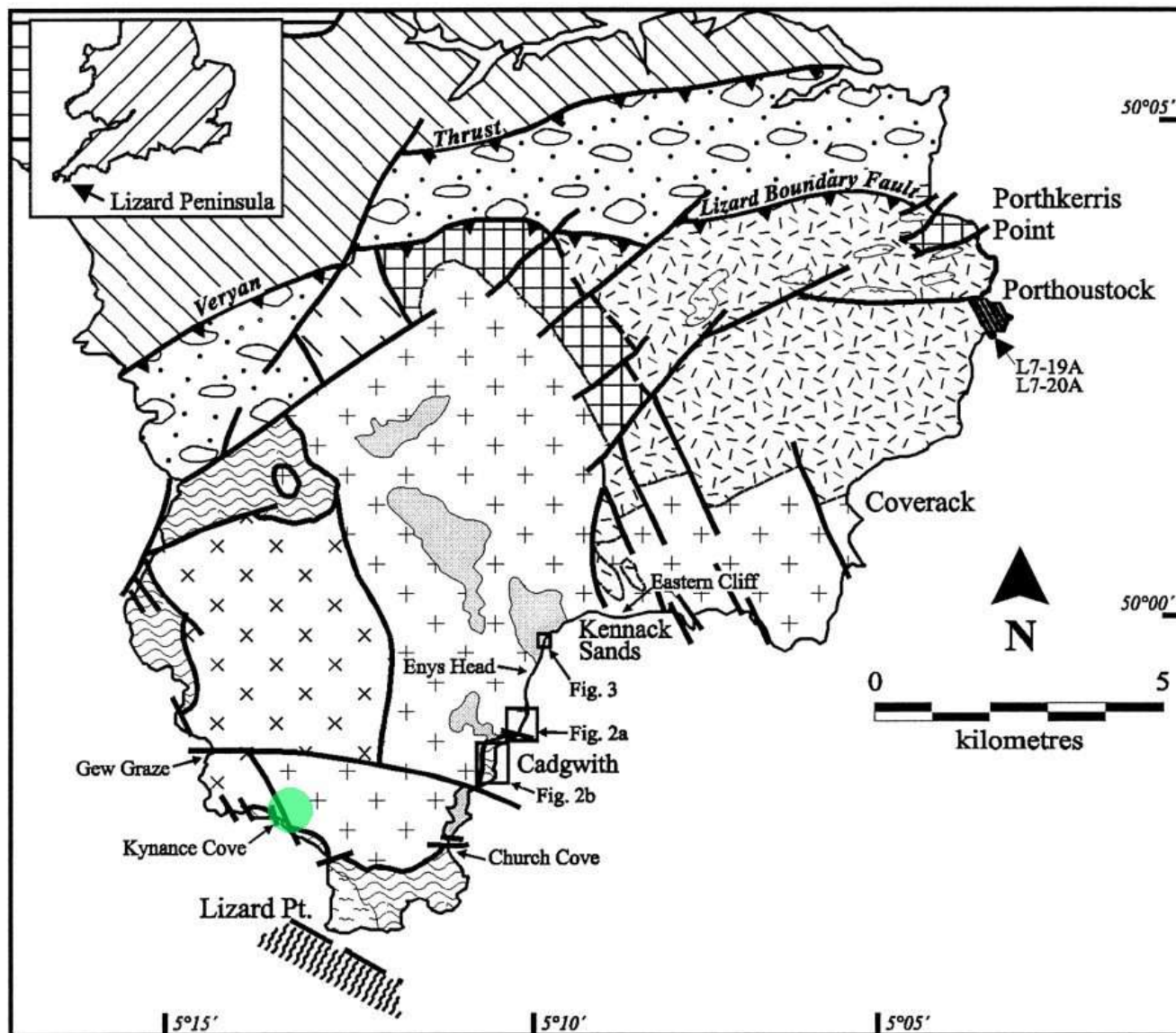
Dunite



Gabbro and Peridotite

Kynance Cove

Friday, 12th April PM



Kynance Cove

- Intertidal and Cliff Exposures
 - Serpentinised Peridotite (Early Devonian)
 - Bastite & Tremolite varieties
 - Minor Granitic & Mafic igneous intrusions
 - Banded Gneiss

KYNANCE COVE



KYNANCE COVE



Tremolite Serpentinite



Microgranite (Beach)



Microgranite Cliff Intrusion

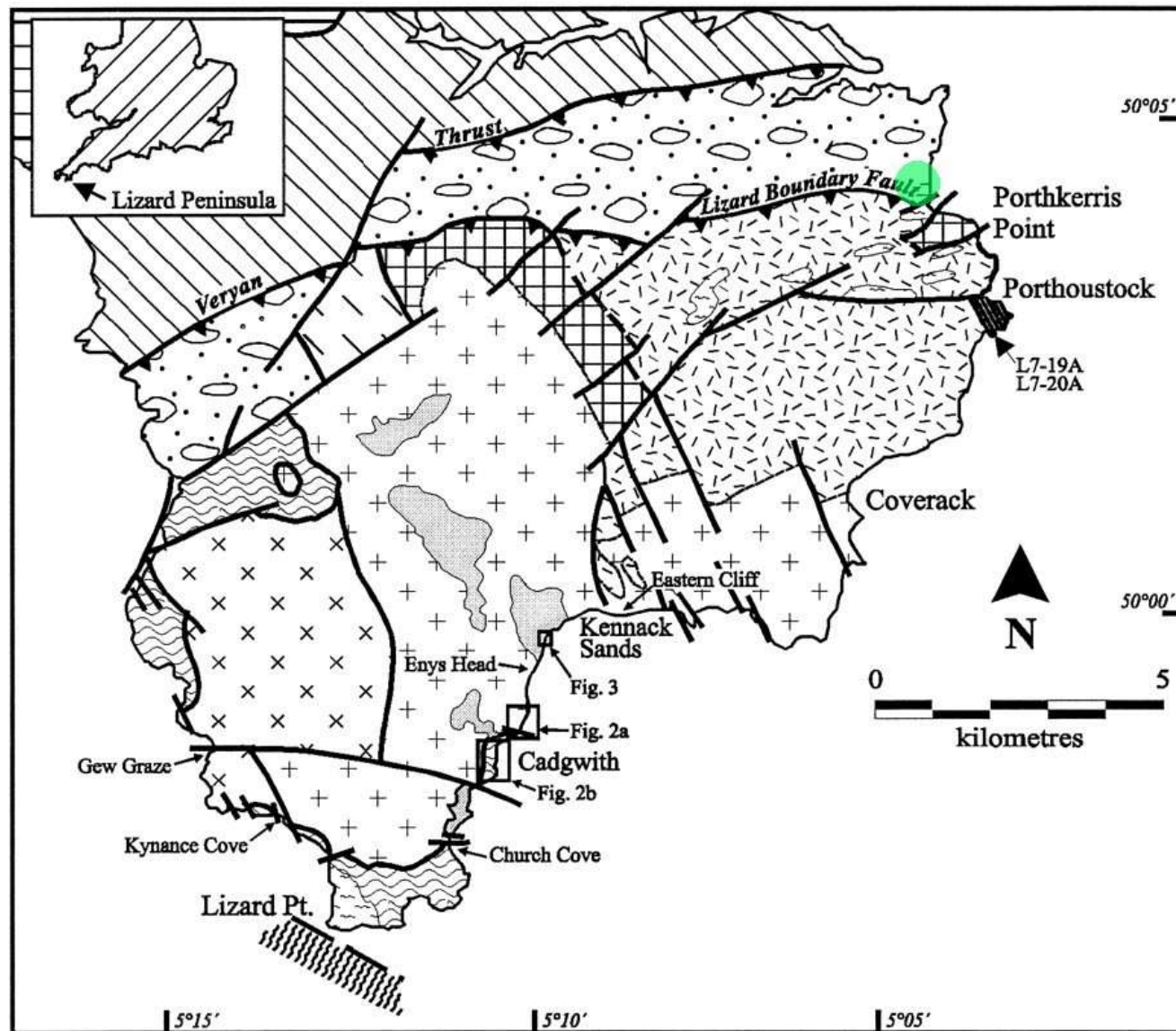


Microgranite (Cliff)

Porthallow

Turnwell Point

Saturday 13th April PM



Porthallow

- Intertidal Exposures (Turnwell Point)
 - Roseland Breccia (Late Devonian)
- Cliff Exposures (North Porthallow Cove)
 - Roseland Breccia Formation with low grade metamorphism during Variscan Orogeny
- Lizard Boundary Thrust
 - Fault between Gramscatho Group and Lizard Complex

PORTHALLOW



Porthallow Cove



Spilite



Flaser Gabbro



Flaser Gabbro with Calcite Vein

PORTHALLOW



Amphibolite / Hornblende Schist



Hornblende Schist Types



Hornblende Schist Types

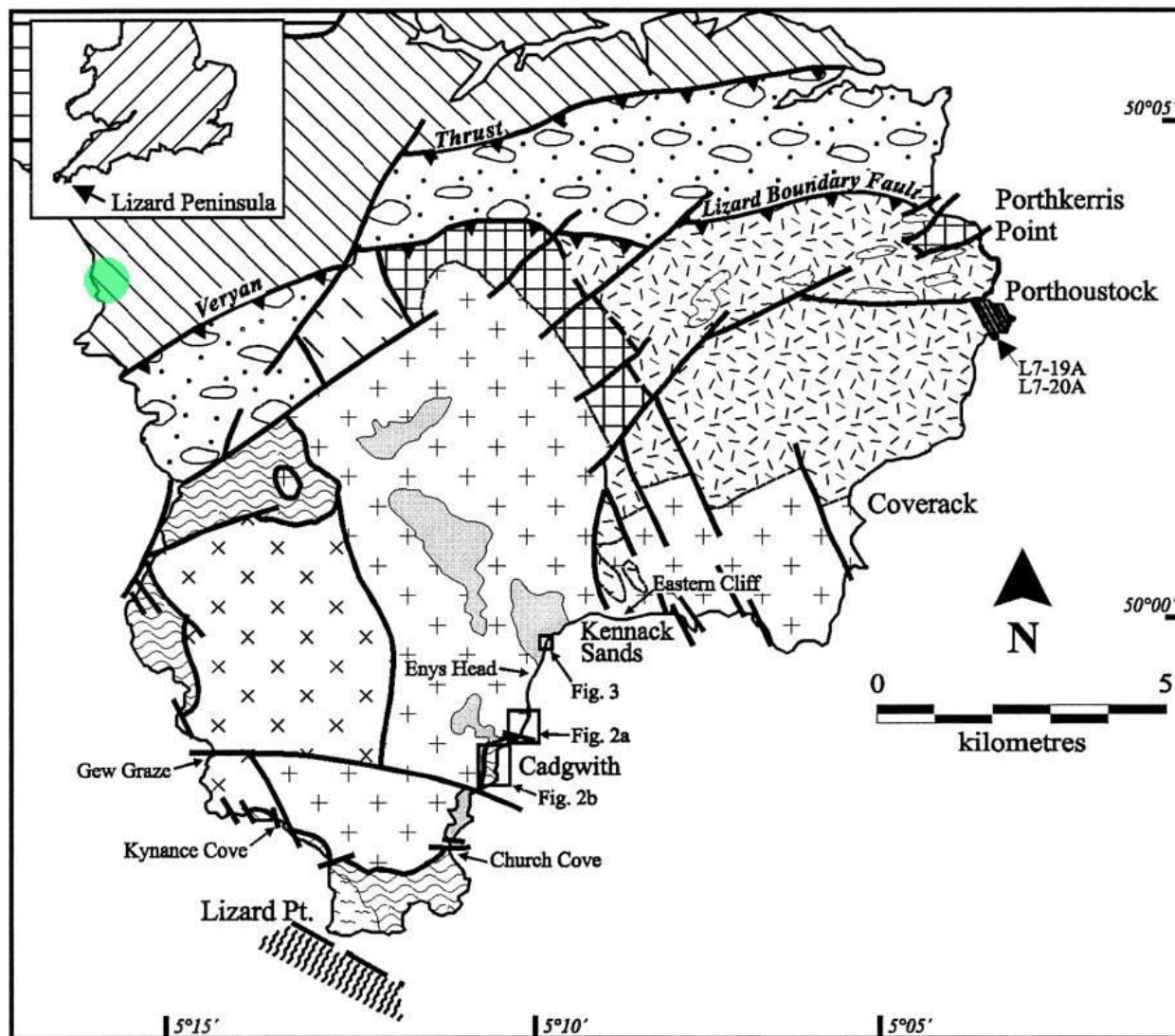


Antigorite Serpentine

Gunwalloe

Church Cove

Saturday 13th April PM



-  Meneage Formation
-  Mylor Slate Formation
-  Portscatho Formation
- Lizard Ophiolite Complex**
-  'Primary' peridotite
-  Recrystallized peridotite
-  Traboe Cumulate Complex
-  Crousa and Trelan Gabbros
-  Sheeted dyke complex
-  Lower Hornblende Schists
-  Upper Hornblende Schists
-  Old Lizard Head Series
-  Kennack Gneiss
- Tremadocian Arc Fragment**
-  Man of War Gneiss
-  thrust
-  fault (undiff.)

Gunwalloe

- Cliff Exposures
 - Portscatho Formation (Middle Devonian)
 - Alternating grey or greenish grey, sandstones and mudstones (slates) along with less abundant siltstones
 - Greywacke (Dirty Sandstone)
 - Folding, faulting & low grade metamorphism during Variscan Orogeny

GUNWALLOE (JANGE-RYN)



Beach



Cliff



Antigorite



Cliff - Portscatho Slate Formation

GUNWALLOE (JANGE-RYN)



Portscatho Formation Faulting + Folding



Thrust Fault



Slate from Cliff (+Rust)



Greywacke

GUNWALLOE (JANGE-RYN)

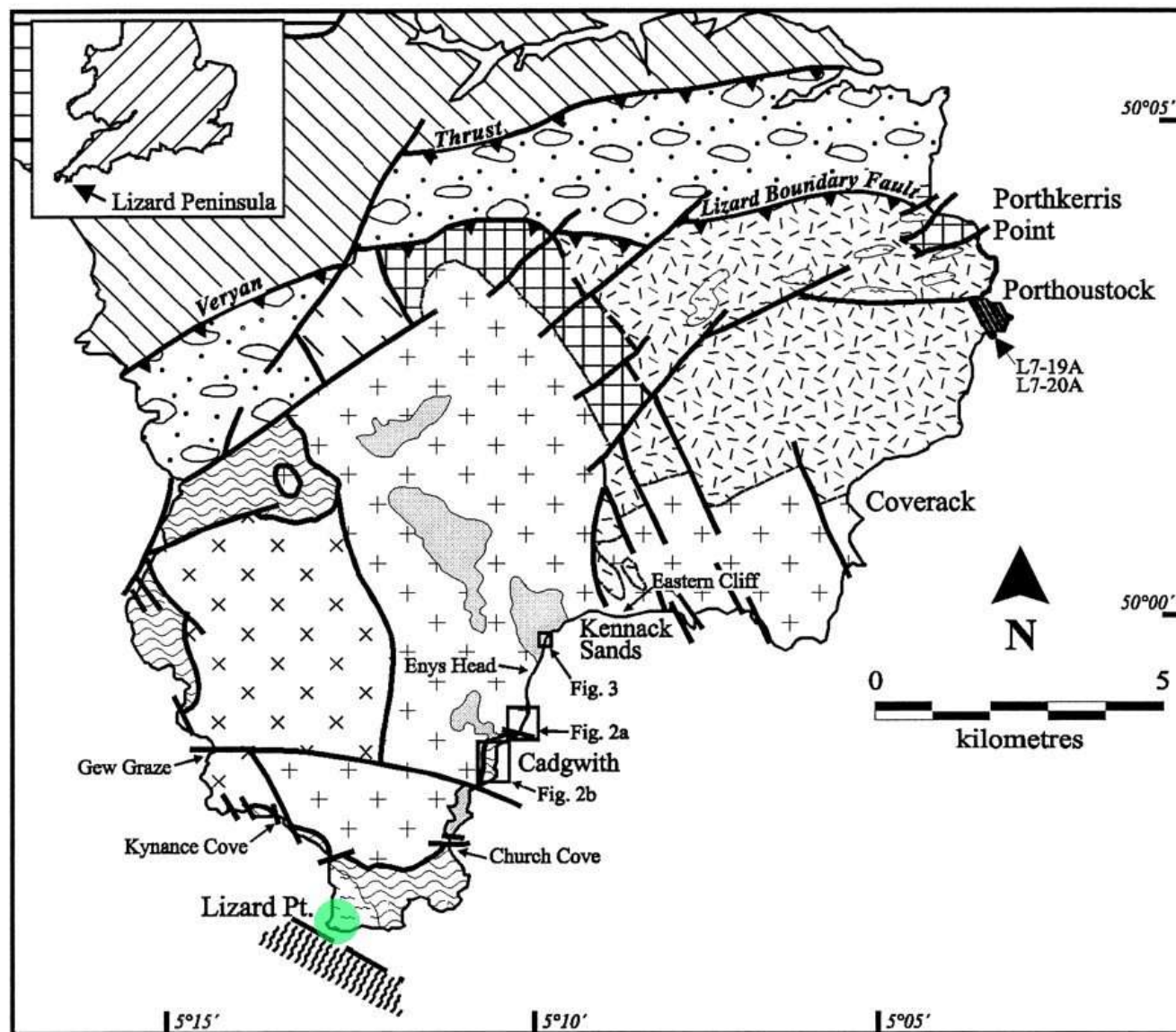


Examples of Greywacke with Quartz Veins

Lizard Point

Southerly Point

Sunday 14th April AM



Lizard Point

- Metamorphic Basement (Cambrian/Ordovician)
 - Thrust faulted against Lizard Complex rocks
 - Lizard Head Series
 - Schists & Gneisses
 - Man of War Gneiss
 - Offshore and beach pebbles

LIZARD POINT



Lizard Point



Man of War Rocks



Lizard Head [Schists](#)



Lizard Head [Mica Schist](#)

LIZARD POINT



Lizard Head [Gneiss](#) Types



Lizard Head [Gneiss](#)



Man of War [Gneiss](#) 1

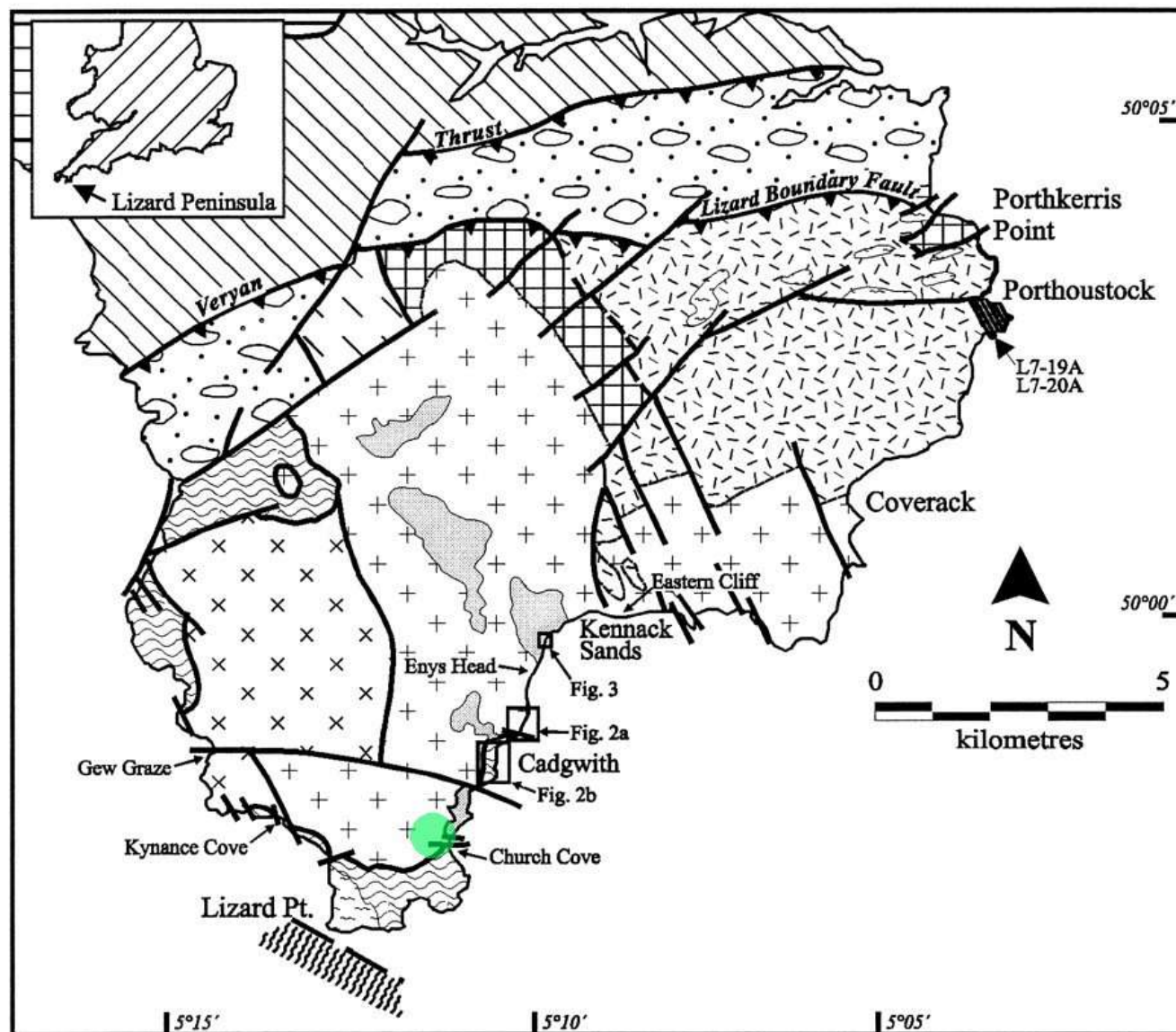


Man of War [Gneiss](#) 2

Landewednack

Church Cove

Sunday 14th April AM



Landewednack – Church Cove

- Hornblende Schist (Early Devonian)
 - ‘Landewednack’ type
- Lystric Fault in Quarry above Church Cove
 - Landewednack HS (Under)
 - Peridotite (Over)

LANDEWEDNACK – CHURCH COVE



LANDEWEDNACK – CHURCH COVE



Examples of [Hornblende Schist](#) + [Epidote](#) (Protolith - Pillow Lavas)



LANDEWEDNACK - QUARRY



Talc Veins in Peridotite



Talc

LANDEWEDNACK _ QUARRY



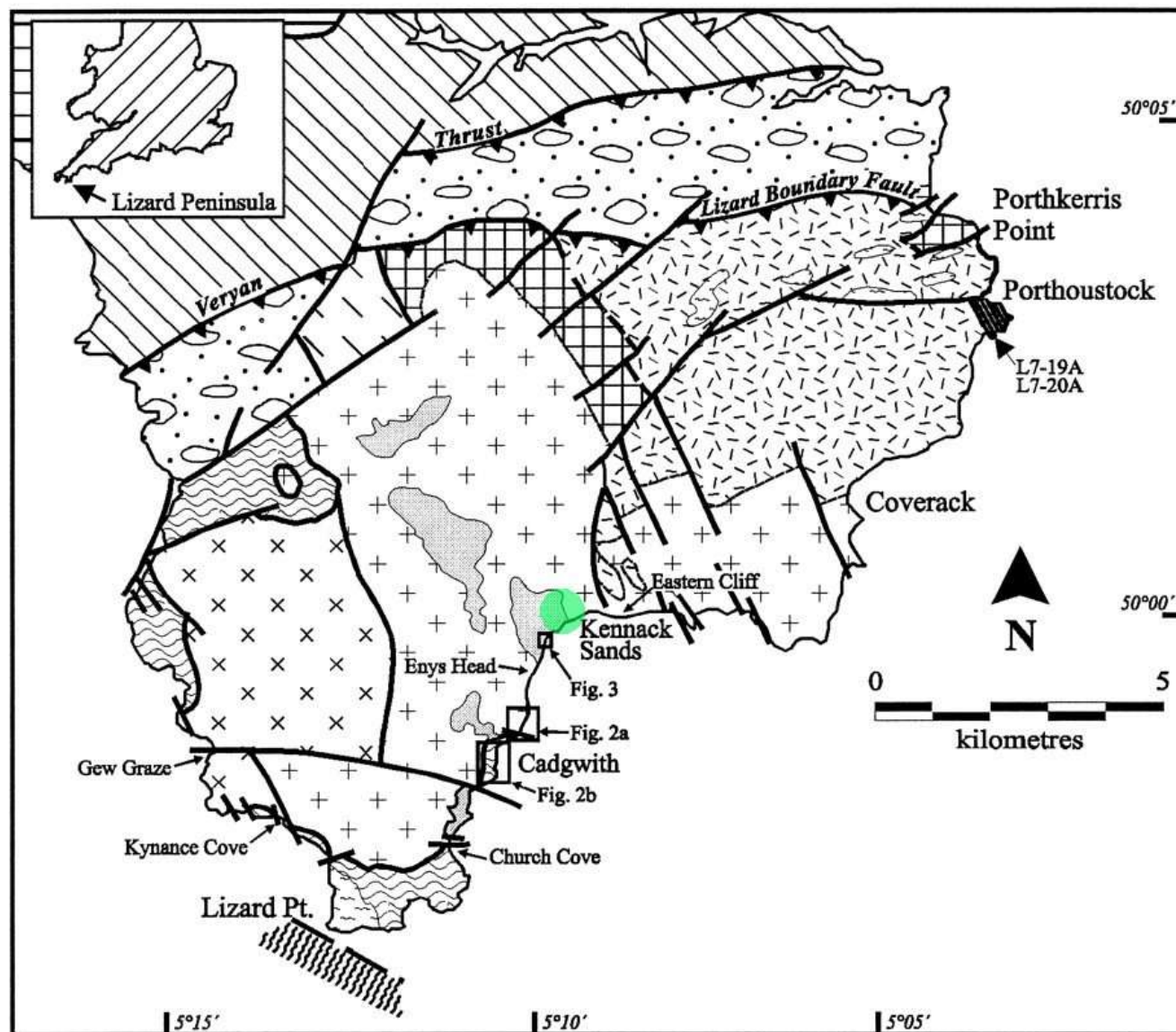
Lystric Fault ([Peridotite](#) over Landewednack [Hornblende Schist](#))



Examples of modified [Hornblende Schist](#) from Fault

Kennack Sands

Sunday 14th April PM



Kennack Sands

- Intertidal and Cliff Exposures
 - Kennack Gneiss (Early-Late Devonian)
 - Mafic Granitic & Basaltic Intrusions (Dykes)
- Adjacent Bastite Peridotite
 - Localised part-alteration to Serpentinite
 - Incorporated Magnetite (Black)

KENNACK SANDS



Bastite Peridotite in Wall



The Class !

KENNACK SANDS



Kennack Gneiss



Kennack Gneiss Components - Basalt (Grey) / Feldspar Microgranite (Pink)

KENNACK SANDS



Peridotite + Magnetite



Chrysotile (White Asbestos) Vein



Chrysotile (White Asbestos)

Rock Types 1

- Peridotite
 - A dense coarse-grained ultramafic (< 45% Silica) igneous rock consisting mostly of Olivine and Pyroxene. It is derived from the Earth's Mantle. Exact compositions vary widely giving different colours and textures (and names!). Basically a Magnesium Iron Polysilicate with many other minor additions possible
- Bastite
 - A variety of the Serpentine group
- Basalt
 - An extrusive igneous volcanic rock formed by the rapid cooling of lava near the surface. Fine grained and usually grey to black in colour. Typically rich in Magnesium and Calcium Oxides with around 45% Silica. A wide range of compositions with many trace element combinations
- Troctolyte
 - An intrusive igneous olivine-rich, pyroxene-depleted relative of Gabbro
- Gabbro
 - a large group of dark, coarse-grained, intrusive mafic igneous rocks chemically equivalent to basalt. The rocks are plutonic, formed when molten magma is trapped beneath the Earth's surface and cools into a crystalline mass

Rock Types 2

- Dunite
 - Dunite is the igneous ultramafic olivine-rich end-member of the peridotite group of mantle-derived rocks
- Serpentinite
 - A rock composed of one or more serpentine group minerals. Minerals in this group are formed by **serpentinization**, a sea water hydration and metamorphic transformation of ultramafic rock (Peridotite) from the Earth's mantle. The alteration is particularly important at the sea floor at tectonic plate boundaries.
- Granite
 - a common type of intrusive, felsic, igneous rock which is granular and phaneritic (grains visible to the naked eye) in texture. This rock consists mainly of quartz, mica, and feldspar. **Microgranite** is defined as when grain sizes are only visible under a microscope.
- Amphibolite
 - a grouping of metamorphic rocks composed mainly of amphibole and plagioclase feldspars, with little or no quartz. It is typically dark-coloured and heavy, with a weakly foliated or schistose (flaky) structure. The small flakes of black and white in the rock often give it a salt-and-pepper appearance.
 - Amphiboles are minerals of either igneous or metamorphic origin; in the former case occurring as constituents (hornblende) of igneous rocks, such as granite, diorite, andesite and others

Rock Types 3

- Hornblende
 - a common constituent of many igneous and metamorphic rocks such as granite, syenite, diorite, gabbro, basalt, andesite, gneiss, and schist.
 - an isomorphous mixture of three molecules; a calcium-iron-magnesium silicate, an aluminium-iron-magnesium silicate, and an iron-magnesium silicate.
- Hornblende Schist
 - composed principally of hornblende, with a variable quantity of feldspar, and sometimes grains of quartz. Usually black.
- Antigorite
 - Antigorite is the polymorph of serpentine that most commonly forms during metamorphism of wet ultramafic rocks and is stable at the highest temperatures
- Tremolite
 - a member of the amphibole group of silicate minerals. The fibrous form of Tremolite is one of the six recognised types of Asbestos
- Slate
 - a fine-grained, foliated, homogeneous metamorphic rock derived from an original shale-type sedimentary rock composed of clay or volcanic ash through low-grade regional metamorphism. It is the finest grained foliated metamorphic rock

Rock Types 4

- Greywacke
 - variety of smooth sandstone generally characterized by its hardness, dark colour, and poorly sorted angular grains of quartz, feldspar, and small rock fragments or lithic fragments set in a compact, fine clay matrix
 - Greywackes are mostly grey, brown, yellow or black, dull-coloured sandy rocks which may occur in thick or thin beds along with slates and limestones. Its formation is attributed to submarine avalanches or strong turbidity currents
- Quartz
 - the second most abundant crystal mineral in the Earth's continental crust, after feldspar. It is made up of a continuous framework of SiO_4 silicon–oxygen tetrahedra.
- Mica Schist
 - a medium-grade metamorphic rock with medium to large grains of mica flakes in a preferred orientation.
 - Most schists have been derived from clays and muds which have passed through a series of metamorphic processes involving the production of shales, slates and phyllites as intermediate steps

Rock Types 5

- Gneiss
 - a common and widely distributed type of rock formed by high-grade regional metamorphic processes from pre-existing formations that were originally either igneous or sedimentary rocks. It is foliated (composed of layers of sheet-like planar structures). The foliations are characterized by alternating darker and lighter coloured bands, called "gneissic banding". The banding is developed under high temperature and pressure conditions
- Epidote
 - a calcium aluminium iron sorosilicate (Si_2O_7) mineral
 - an abundant rock-forming mineral, but one of secondary origin. It occurs in marble and schist rocks of metamorphic origin. It is also a product of hydrothermal alteration of various minerals (feldspars, micas, pyroxenes, amphiboles, garnets, and others) composing igneous rocks
- Talc
 - a mineral composed of hydrated magnesium silicate resulting from the metamorphism of magnesian minerals such as serpentine, pyroxene, amphibole, olivine, in the presence of carbon dioxide and water
 - The softest naturally occurring mineral

Rock Types 6

- Feldspar
 - A group of rock-forming tectosilicate (three-dimensional framework of Silica tetrahedral crystals) making up around 60% of the Earth's crust
 - Three basic types: Na/Al (Albite); Ca/Al (Anorthite); K/Al (K-Spar)
- Magnetite
 - a black mineral, one of the two common naturally occurring iron oxides (chemical formula Fe_3O_4) and a member of the spinel group. Magnetite is the most magnetic of all the naturally occurring minerals on the Earth
- Chrysotile
 - the most commonly encountered form of asbestos accounting for approximately 95% of naturally occurring asbestos
 - A soft fibrous silicate mineral in the Serpentine group of Phyllosilicates ($\text{Mg}_3(\text{Si}_2\text{O}_5)(\text{OH})_5$)
- Calcite
 - a carbonate mineral and the most stable crystalline polymorph of Calcium Carbonate (CaCO_3)
- Spilite
 - a fine-grained igneous rock, resulting particularly from alteration of oceanic basalt with temperature, pressure and sea water