Locations MT7, MT8 and MT9

Lane cuttings east of Location MT6

These are three exposures along a small lane, each of them on your left as you walk from MT7 to MT9.

The lane along which these exposures are located is on a steep hillside falling away to the south. The lane has been accommodated by the hillside being dug back, creating a cutting several metres high on the north side of the lane.

Safety: While stopping, particularly at Location MT8, take care to listen out for vehicles coming along the road, and stand well back in good time to allow them through if any appear. The lane may seem quiet but there are farms and houses along here and traffic does come.

It may be a good idea to read quickly through the information for all three locations while you are in a safe spot near MT7, so that you are prepared to gather your observations and data promptly at MT8 and MT9.

Location MT7 (SO 7420 6401)

This first exposure, MT7 is very overgrown with vegetation, but look briefly at it as the character of the rock can still be made out.
It can be seen more clearly at the next exposure, MT8.

Photo of MT7

Location MT8 (SO 7422 6402)

Photo of MT8

* Look at exposure MT8. The rock is not as clearly bedded as that seen at Location MT6. Looking closely, it has instead an equally distinct, but different structure. Which of the following terms would best describe this: nodular / massive / channelled

Is there any other general sense of structure in the rock here? Is it:
near-vertical / near-horizontal / inclined.

Determining a strike direction of the rock is difficult here, but choose which would you think most likely?
East-west / north-south / north-east to south-west.
Is this somewhat similar or different from the strike of the rocks at Location MT6?

* You may be able to see one or two places on this rock face where the rock has been broken open and is unweathered. The rock is very hard; it is grey, and comprised of angular particles mostly between 0.25 – 0.5 mm in size. It does not have the silky feel that the rock at Location MT6 has, indicating that clay is absent.
The rock is (choose either):
very well-sorted / poorly sorted.

If a drop of dilute (10%) hydrochloric acid is put on this fresh rock, it will effervesce rapidly and continuously, indicating it contains abundant calcium carbonate.
Laboratory microscope work would show that the particles are similar in origin to those described at Location MT6, only a little larger.
The rock is of sedimentary origin, and is a (choose one):
sandstone / shale / limestone.

There are no fine structures e.g. laminations present. This lack of structures like laminations or bedding types suggests that when the sediment was still soft, before it became cemented, it was thoroughly bioturbated by burrowing organisms, which would have destroyed any of the above structures.

Many sedimentary rocks rich in calcium carbonate are very susceptible to change – particularly when they have become buried under more sediment on top. In this burial environment, temperatures rise and pressures increase, which can cause varying degrees of re-crystallisation of the rock particles and segregation of materials which have different mineral compositions (such as fine fragments of broken shells separating from quartz-rich silt and clay). This can produce a rock which has an appearance very different from the original deposited sediment. A *nodular* structure is commonly developed. This can happen in addition to the cementing process that turns the soft sediment into a resistant rock, as water rich in dissolved calcium carbonate in the loose sediment precipitates out, creating crystals that form a cement.

Using your answers to the above questions, decide which of the following (a) or (b) is likely to be true:

(a) A subaqueous surface was occupied by numerous shelly invertebrates which were repeatedly ground down by powerful storm-driven currents to form a widespread, very well-sorted sand-grade carbonate deposit. The overlying water had little clay or silty material in it, and was consequently very clear. Upon burial, as temperatures and pressures were raised, the sediment became cemented and developed a distinct nodular structure.

(b) A subaqueous surface was occupied by numerous shelly invertebrates which were repeatedly ground down by powerful storm-driven currents to form a widespread, very well-sorted sand-grade carbonate deposit. Additional powerful storm currents washed into the area many rounded limestone pebbles, and these became mixed with the sand-grade carbonate deposit. Upon burial, as temperatures and pressures were raised, water containing dissolved calcium carbonate crystallised out, turning the pebbly sand-grade sediment into a hard rock.

The environment the grey sedimentary rock at this locality was formed in was (choose the most likely option):
a swamp / a shallow sea / a hot desert.

Location MT 9 (SO 7438 6398)

Photo of MT9

These rocks are softer than those examined at MT7 and MT8; you are likely to find some loose pieces around on the banks here. Collect one or two pieces.

 * The rock contains many small fossil invertebrate shellfish remains. Many of the original shells (made of calcium carbonate) have been dissolved away; the fossils include remains of brachiopods. The rock is of sedimentary origin.

* Aim to find a least-weathered edge or face on the pieces you've collected. The least-weathered rock is a greenish-grey colour and has a very 'silky' feel. This indicates it has a significant content of (choose):
feldspar / clay / iron minerals.
Much of the rock is composed of silt-grade quartz, with tiny scattered highly-reflective flakes of the mineral muscovite.
To what mineral group does muscovite belong?

* Look at the rock exposures here. They have a clearly-defined layering from top-right to bottom-left (see photo of MT9). Measure the thickness in millimetres of some of the layers; what thicknesses do you get?
The rock is fine-grained and has an ability to split into thin parallel layers due to its clay and muscovite content; both these latter have flat, smooth crystals enabling this process; this fine-grained-ness and splitting quality both together mean the rock can be referred to as a (choose option:) mudstone / shale / breccia.
The sediment was originally deposited horizontally, and became tilted in the orientation seen today, later.

* Estimate the dip and strike of the bedding of the rock by standing close to the rock and orienting your compass-clinometer similarly to the bedding. Notice that the dip is

somewhat lower at the north end of exposure MT9 and steeper towards the southern end.

Using your answers to the above questions, decide which of the following (a) or (b) is likely to be true:

(a) A subaqueous surface was occupied by numerous shelly invertebrates. The overlying water was often still and contained much suspended silt and clay, which was gradually deposited on the surface below. Many shelly invertebrates remained intact and unbroken in the absence of strong water currents. With burial, the sediment became compacted and as temperatures were raised; calcium carbonate forming the shells was dissolved and removed, and dissolved silica was deposited between the sedimentary grains to form a cement. Later the sedimentary rock was affected by tectonic forces, which tilted them to the orientation we see today. With later release of pressure and exposure, this fine-grained rock developed its characteristic thin layering.

(a) A subaqueous surface was occupied by numerous shelly invertebrates. The overlying water was often still and contained much suspended sand and silt, which was rapidly deposited on the surface below. Many of the shelly invertebrates were broken by strong currents generated by powerful storms. With burial, the sediment became compacted and as temperatures were raised;

calcium carbonate forming the shells was dissolved and re-deposited between the sedimentary grains to form a cement. Later the sedimentary rock was affected by tectonic forces compressing from the south, producing an east-west strike, and a vertical dip. Later the rock recrystallized into a structureless mass.

The environment the green-grey fine-grained sedimentary rock at this locality was formed in was (choose the most likely option):

a swamp / a shallow sea / a hot desert