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4. Define weathering and erosion. Explain how these processes produce sediment.

Weathering and erosion are two powerful forces that operate within the Geosphere, "Any of the almost spherical concentric regions of the earth and its atmosphere, especially the lithosphere.", (Oxford Dictionaries, 2015). Erosion can be defined as, “the physical removal of rock and sediment from its original location by an agent such as water, ice, air, gravity, or animal/human interference.", (DiPietro JA, 2013). The definition of weathering is, “the breakdown, but not the removal of rocks.", (Mayhew S, 2009). This essay will illustrate the processes of weathering and erosion, in relation to the production of sediment. Its purpose is to gain a greater understanding of the complexity and interactions between the processes of weathering and erosion and how they all link to produce sediment. We will focus particularly on two contrasting geographical areas, the mountains and the coast. How these areas weather and erode differently, and produce sediment through the interactions of different mechanisms, are all investigated.

The Cairngorms are an example of mountains that undergo different forms of weathering and erosion. In the Cairngorms, we will investigate; mechanical weathering and erosion by the force of gravity.

Mechanical weathering is defined as, “the breakdown of large masses of solid rock into smaller fragments.", (Trudgill, 1983). This is achieved through a 'freeze-thaw'

mechanism called "Frost shattering, also known as Cryofracture." (Smithson *et al,* 2008). "Upon freezing, water expands by about 9%", (DiPietro JA, 2013). "Thus water trapped in rock pores, joints and cracks will act to stress the rocks upon freezing.", (Trudgill, 1983). In effect, the expandation of the ice crystals will crack and shatter the rock. This is seen in the Cairngorms as, "large areas of broken rock or blockfields which formed as frost and ground-ice shattered the granite bedrock." (Gordon *et al*, 2006).

Figure 1. Blockfield. " 'Blockfields' comprising of large blocks of stone characterise many mountain tops and plateaux in Scotland.", (Gordon *et al*, 2006).

'Gravity' is an erosional mechanism that also occurs in mountains such as the Cairngorms. This is where rock debris from freeze-thaw cycles, (Beek *et al*, 2008), and other erosional processes can flow downslope under gravity. This can take a violent and chaotic form, such as rockfalls and topples. (Beek *et al*, 2008). A rock within a rockfall is more likely to break while freefalling as it collides with other falling material. (Bozzolo

and Pamini 1986). This would increase the rock's surface area for more subsequent weathering and erosion, and in time produce sediment. The slope itself can be eroded in such events, this seen in the residual scars present in many slope landforms. (Smithson *et al,* 2008).

Figure 2. Debris flows. "Debris flows have extensively modified" many of the Cairngorms' slopes. (Gordon *et al*, 2006)

This shows the interactions between different weathering and erosive mechanisms present on the Cairngorms and that rock resistance will be greatly reduced due to weathering, which in turn means the rock can erode easier (via mass movements and the breaking of rocks) and therefore eventually produce sediment.

The coast of South West England is an example of a coastline that will be affected by different forms of weathering and erosion than those in mountains. Here, we will discuss

chemical weathering and bioerosion.

The type of chemical weathering that is active on this coastline is 'Salt weathering' and relies on salt crystallization in voids of the rock. (Smithson *et al,* 2008). It can, "operate along the sea coast where salt spray is blown onto cliffs and where the water subsequently evaporates.", (Trudgill, 1983). "As evaporation proceeds, salt crystals begin to grow in the pore spaces in the rock. If the force exerted by the growing crystal is greater than the mechanical strength of the rock then salt crystal growth can act to prise the rock constituents apart.", (Trudgill, 1983). This mechanism breaks rocks apart, like cryofracture discussed earlier, however, it is the growth of the salt crystals that cause this instead.

Figure 3. "Budleigh Salterton Pebble Bed Cliffs" in Devon, South West England. Evidence of 'salt weathering' is found on the cliffs. (Lu and The Unwitting Traveller,

2011).

Bioerosion is a mechanism that erodes coastlines. The term 'bioerosion' is defined as, “a specific biogeomorphic process which is concerned with the interactions between animals and geomorphic systems” (i.e. zoogeomorphology, Butler, 1995). A recent study by Naylor *et al*. (2012), has further investigated the role of organisms in eroding and shaping coastlines in the South West England area and have concluded that they play a bigger role than once thought. They observed “the complex interactions in rock coast systems" and the how organisms manage to make rocks more prone to erosion. Among many things, they discovered that different organisms were causing erosion at “the micron to cm scale" through grazing or boring and that this "modified zone" they created was susceptible to other “chemical and mechanical processes such as salt crystallisation." (Naylor et al, 2012).

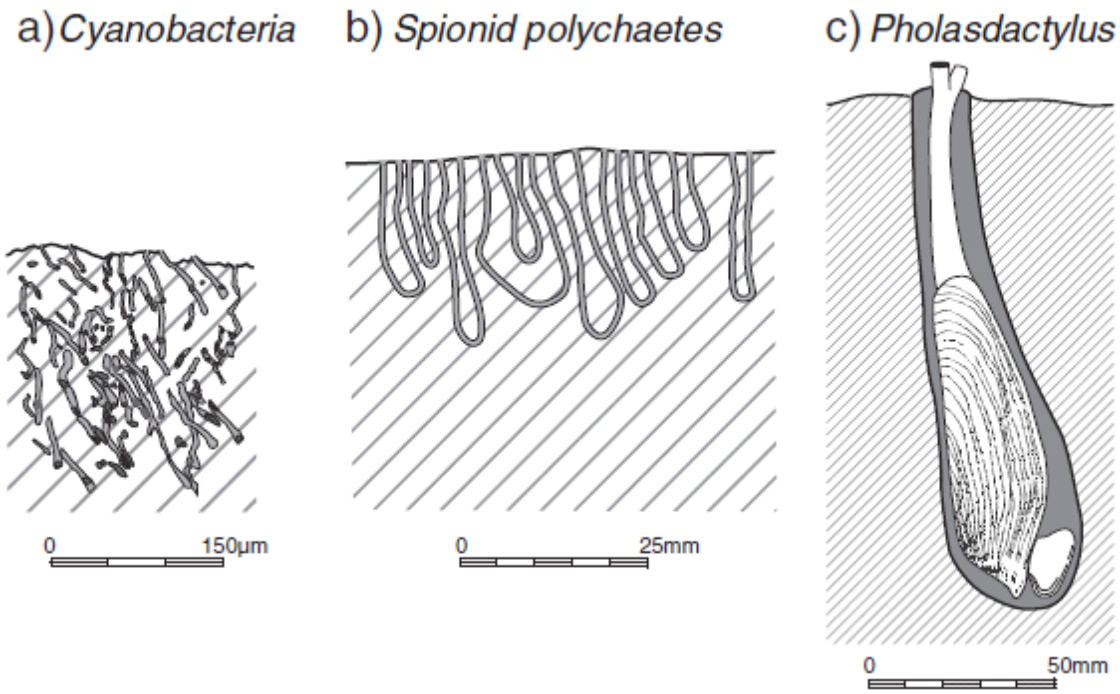

Figure 4. "Bioerosion (boring) at three different scales: a) micro-scale (μm) cyanobacteria, b) macro-scale (mm) spinoid polychaetes and c) macro-scale (cm) Pholasdactylus". (Naylor et al, 2012).

Various mechanisms of weathering and erosion operate on coastlines. Like the processes on mountains discussed previously, there is a clear interaction between the separate destructive mechanisms, in relation to how they breakdown rock and how this produces sediment.

Sediment can be defined as, “Material which has separated and settled out from the medium—wind, water, or ice—which originally carried it.", (Mayhew S, 2009). Sediment is the product of the weathering and erosion processes and as shown, it is produced from the breakdown of rock via various mechanisms and interactions mentioned. This constant, large scale destruction of the land to produce sediment is known as 'denudation'. It, “describes the overall degradation and leveling of a continental land mass ", (Smithson *et al,* 2008) in which the processes of weathering and erosion play a significant part.

Throughout this discussion, a correlation between weathering and erosion has started to emerge. For example, sand grains are a product of physical weathering, (Smithson *et al,* 2008), Sand can cause abrasion, weakening a rock surface, making it more prone to erosion, resulting in more rock being removed, (Naylor et al, 2012). This shows that, "The break-down of rock through the weathering process facilitates erosion.", (DiPietro JA, 2013) and that weathering and erosion are clearly linked. However, it is important to remember that both processes can perform independently from each other. “Erosion

may be enhanced by prior weathering, but weathering is not a prerequisite for erosion.", (Trudgill, 1983). This highlights the great, continuous cycle of weathering, erosion and deposition of sediment that operates within the geosphere. It is this, which establishes a clear link, between the two destructive processes and their interacting mechanisms.

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