Hello students, I am Malcolm Afonso, faculty from the Department of Geology, Parvatibai Chowgule College of Arts and Science Autonomous, Margao Goa. As part of the DISHTAVO initiative of the Directorate of Higher Education. I'm going to present a topic in sedimentary pathology. My topic is shape of grains, fabric and framework geometry, porosity and permeability.

In this topic, we are going to cover the introduction, shape of grains, fabric and framework, geometry which includes grain packing, grain orientation, green contacts, porosity, primary porosity, secondary porosity and permeability.

By the end of this topic, students will be able to describe the shape of sediment particles,
understand the concept of sedimentary rock fabrics. Identify and describe sedimentary rock fabrics. Understand the concept of porosity and permeability.

Shape of a grain encompasses all aspects of external grain morphology. Three of the most commonly used characteristics to express shape of sedimentary particles include

Form: refers to the gross, overall morphology or configuration of particles. Various indices have been used to describe the form of grains e.g on the basis of the ratio of length, breadth and width grains may be classed as tabular, equant, bladed or prolate.

Sphericity: It is a measure of how closely the grain shape approaches that of a sphere.

Roundess: It is Roundness is a measure of the sharpness of the corners of a grain

Roundness and sphericity have proven to be useful properties of particles (greater than sand size) when investigating the transport and deposition of sedimentary material.

Most clast fragments start with some sharp edges due to the bedrock’s crystalline structure, and those points are worn down during transport. More rounded grains imply a longer erosion time or transport distance, or more energetic erosional process.

Fabric refers to the textural characteristics displayed by aggregates of grains or the spatial arrangement and orientation of the fabric elements.

Fabric elements – A single crystal, a pebble or sand grain, a shell, or any other component.

Why are Geologists interested in Fabrics of Sedimentary Rocks?

- Most studies on fabrics of sedimentary rocks have been focused on the reconstruction of the current direction that prevailed at the time of the deposition of the sediment.
- Fabrics also have an important influence on the physical properties of rocks as well particularly the porosity and permeability of rocks and therefore its ability to hold and/or transmit fluids such as oil and water.

Fabric covers three properties of grain aggregates

Grain packing- Spacing or “density” of the fabric elements.

Grain orientation- Any non spherical element has an orientation e.g., pebble. Orientation can be described in terms of Azimuth i.e., angle between some axis of the pebble and the meridian and Dip- which refers to the angle between the axis in question and the horizontal.

Grain Contacts – Nature of contacts between the grains

Packing refers to the distribution of grains and intergranular spaces (either empty or filled with cement or fine grained matrix) in a sedimentary rock.

The packing of sediment grains is an important consideration because it affects porosity and permeability. Grain packing is controlled by grain size and shape and by the degree of compaction of a sedimentary rock.

Genetically, there are two principal varieties of oriented fabrics

Primary (or depositional)- produced while the sediment is accumulating.

Secondary (or deformational)- result from a rotation of the constituent elements under stress or from the growth of new elements during diagenesis.

Platy, flaky, or elongated particles in sedimentary rocks commonly display some degree of orientation that reflects the nature of the depositional process. For example, small platy or flaky particles settling from suspension onto a flat bed in the absence of current flow are commonly deposited with their flattened dimensions parallel to bedding surfaces.

Point contacts: The grains are touching each other (giving the sediment a grain/clast-supported fabric)

Concavo-convex contacts- where one grain has penetrated another.

Sutured contacts- where there is a mutual interpenetration of grains

Matrix-supported- where grains may not be in contact, but 'float' in the matrix

Porosity is the percentage of open space within an unconsolidated sediment or a rock.

Primary porosity is represented by the spaces between grains in a sediment or sedimentary rock. Originates during the deposition of sediments, lithification or cooling of crystalline rock

Secondary porosity is porosity that has developed after the rock has formed. It can include fracture porosity—space within fractures in any kind of rock. Originates as the earth material is exposed to other conditions such as compaction, weathering, fracturing and/or metamorphism.

The primary porosity of granular material is affected

- Shape and packing of grains
- The distribution of grain sizes (sorting and uniformity)
- The porosity of the particles themselves
- The degree of cementation during lithification of sedimentary rocks will also affect the primary porosity.

In this figure we can see Effect of particle shape, arrangement, sorting, cementation, and porosity of particles themselves on the number and size of pore spaces.

Here we can see how fracturing and dissolution can give rise to secondary porosity.

Permeability is a measure of the degree to which the pore spaces are interconnected, and the size of the interconnections.

Low porosity usually results in low permeability, but high porosity does not necessarily imply high permeability.

It is possible to have a highly porous rock with little or no interconnections between pores.

Thank you.