

Sand in Forensic Geology

Modified from a PowerPoint presentation by J.
Crelling, Southern Illinois University

Characterizing Properties of Sand

Remember that sand is actually a size of sediment

Characterizing Properties of Sand

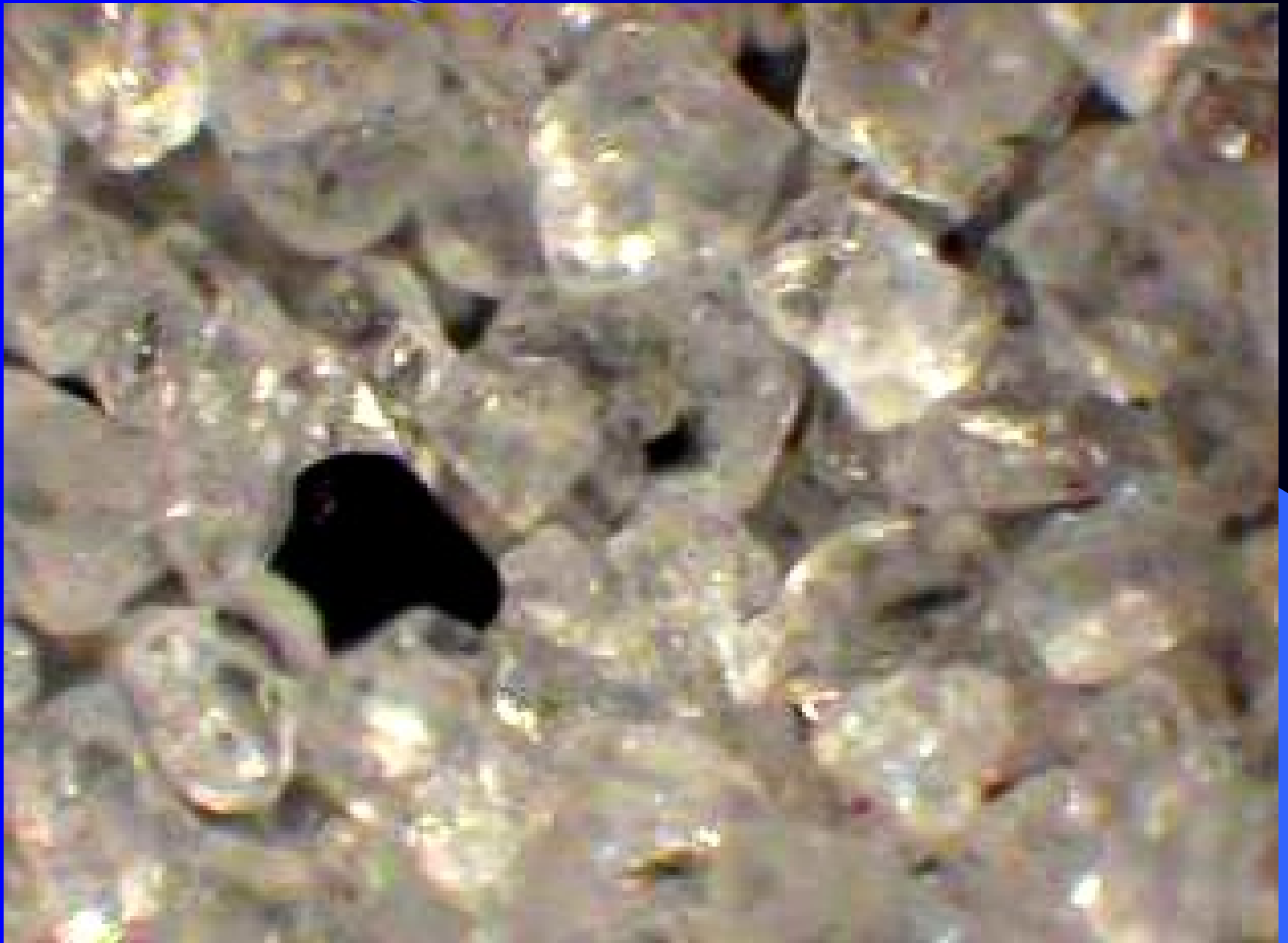
- **Composition**
- **Particle size distribution**
- **Surface Texture**
- **Roundness and Sphericity**

Characterizing Properties of Sand

Composition

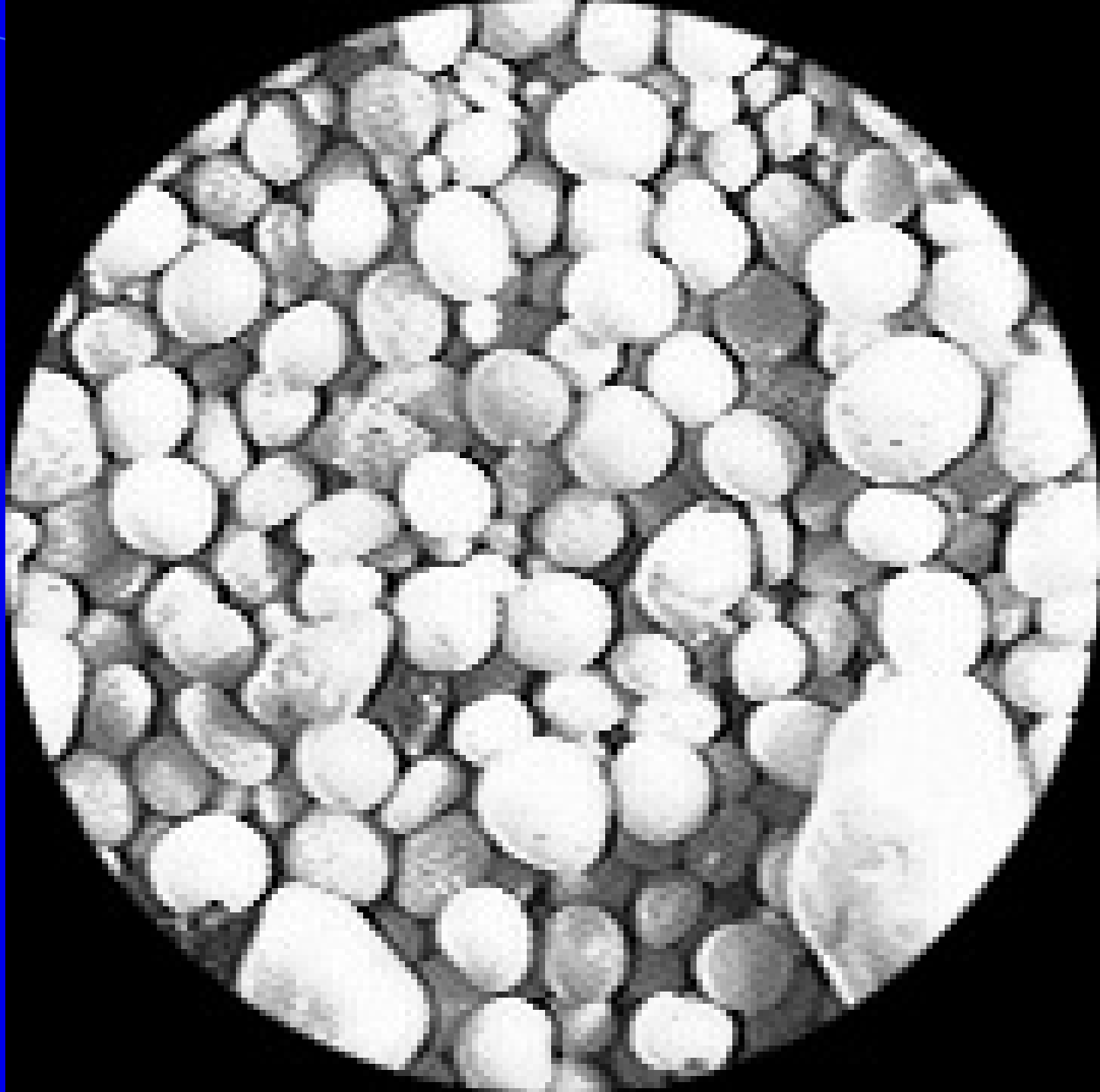
While sand typically is made up of Quartz (SiO_2) it can in fact be composed of almost any mineral or combination of minerals or even sand sized fragments of rocks

Quartz Sand, Panama City Beach, Florida

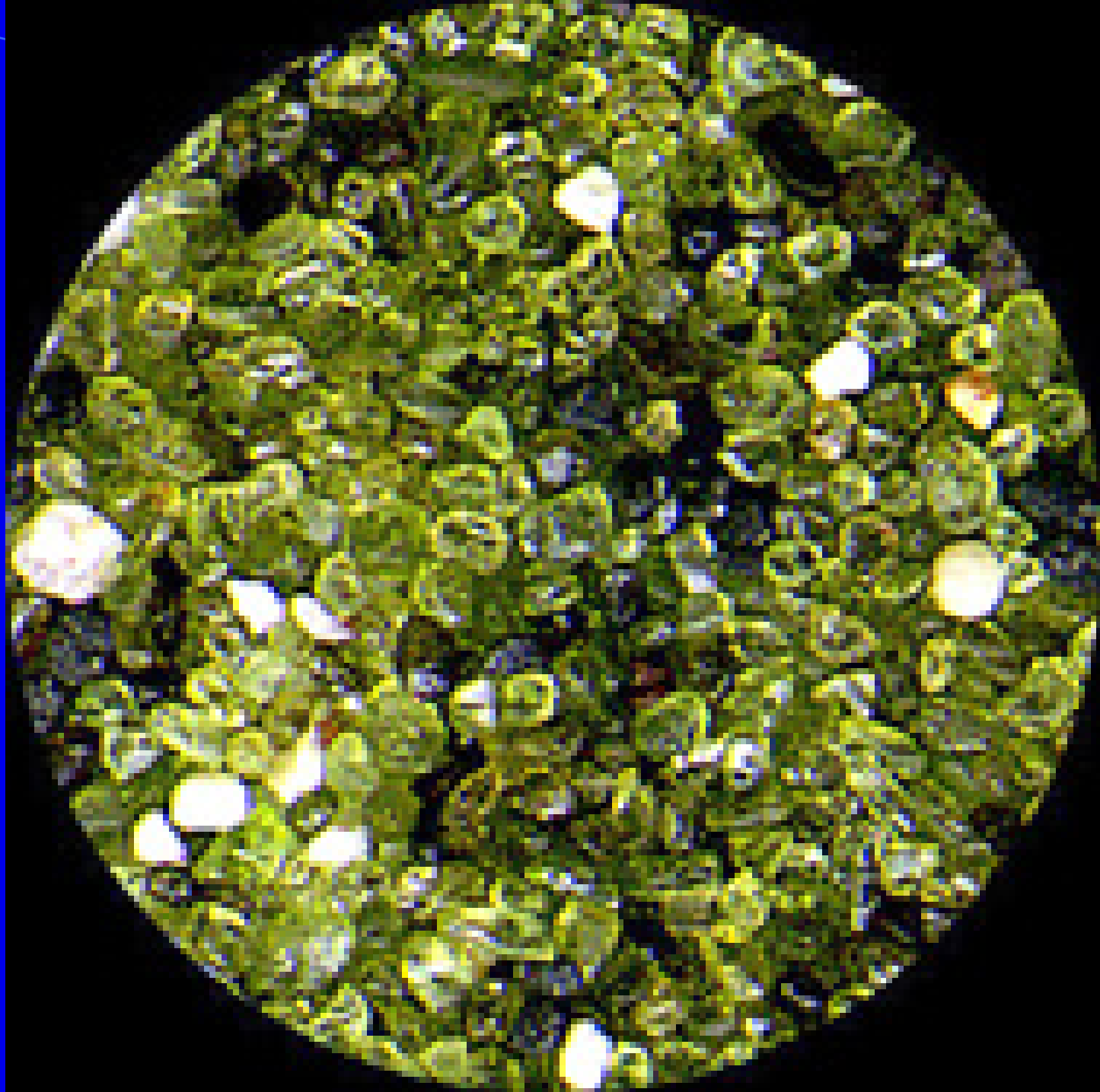


**Oolitic
sand,
Great Salt
Lake,
Utah**

**(Organic
Calcium
carbonate)**



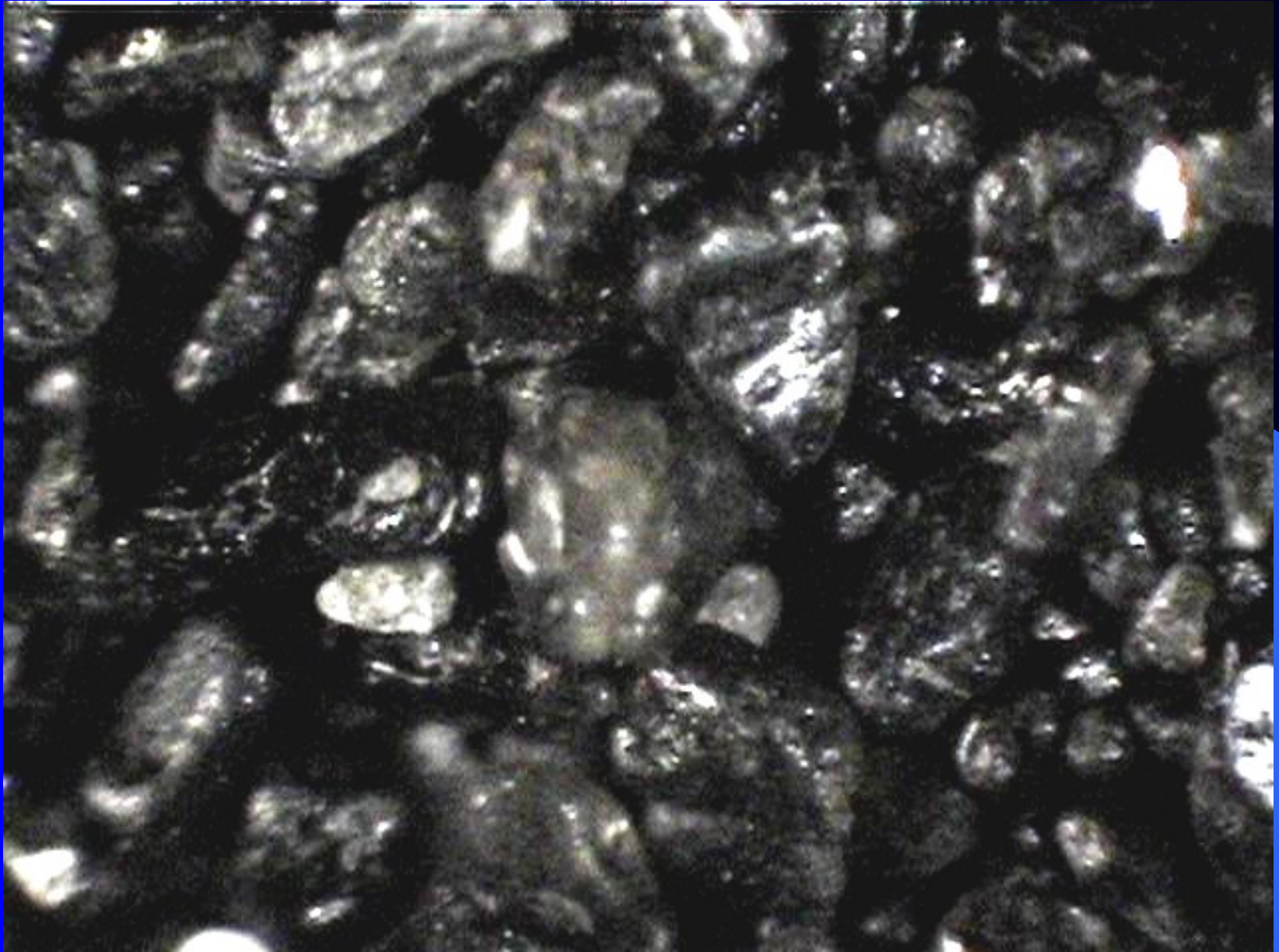
**Olivine
Sand,
Hawaii**



Gypsum Sand, New Mexico



Magnetite Sand, New Zealand



Basalt Sand, Hawaii



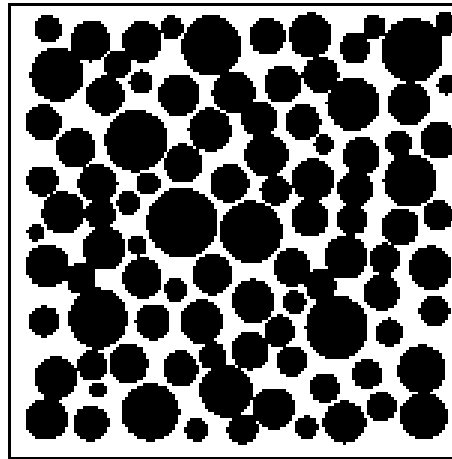
Characterizing Properties of Sand

Particle Size and Distribution

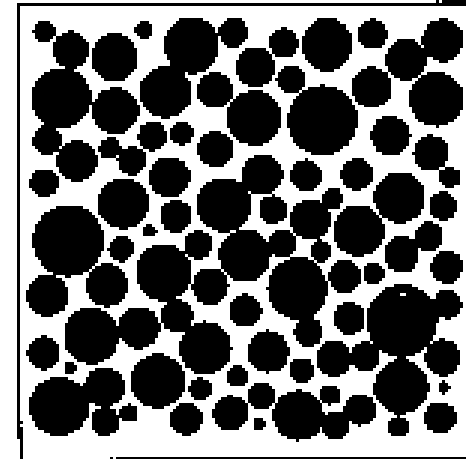
The source rock and weathering and transportation history of a sand usually results in a particle size distribution that can be characteristic of a sample

**Correlation
between the
standard deviation
(sorting) of a
sample and its
physical
appearance.**

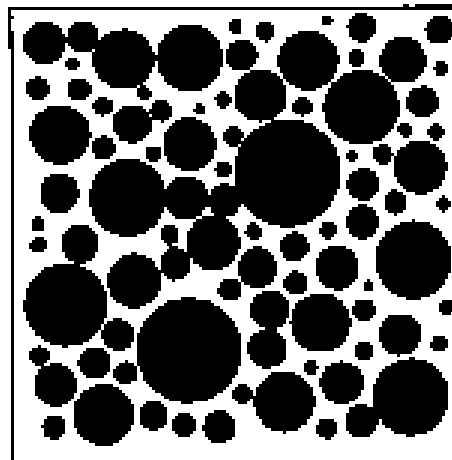
Very well sorted	'Standard deviation' < 0.35
Well sorted	= 0.35-0.5
Moderately well sorted	= 0.5-0.71
Moderately sorted	= 0.71-1.0
Poorly sorted	= 1.0-2.0
Very poorly sorted	> 2.0



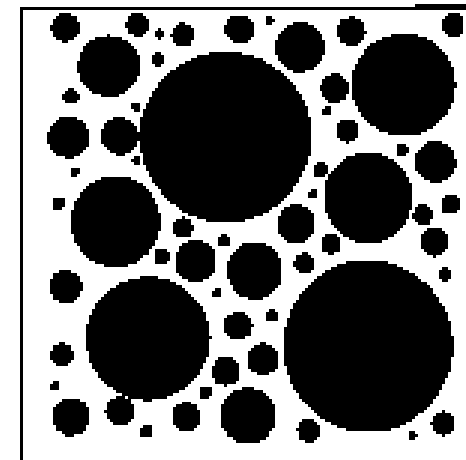
'Standard deviation' = 0.35



'Standard deviation' = 0.5



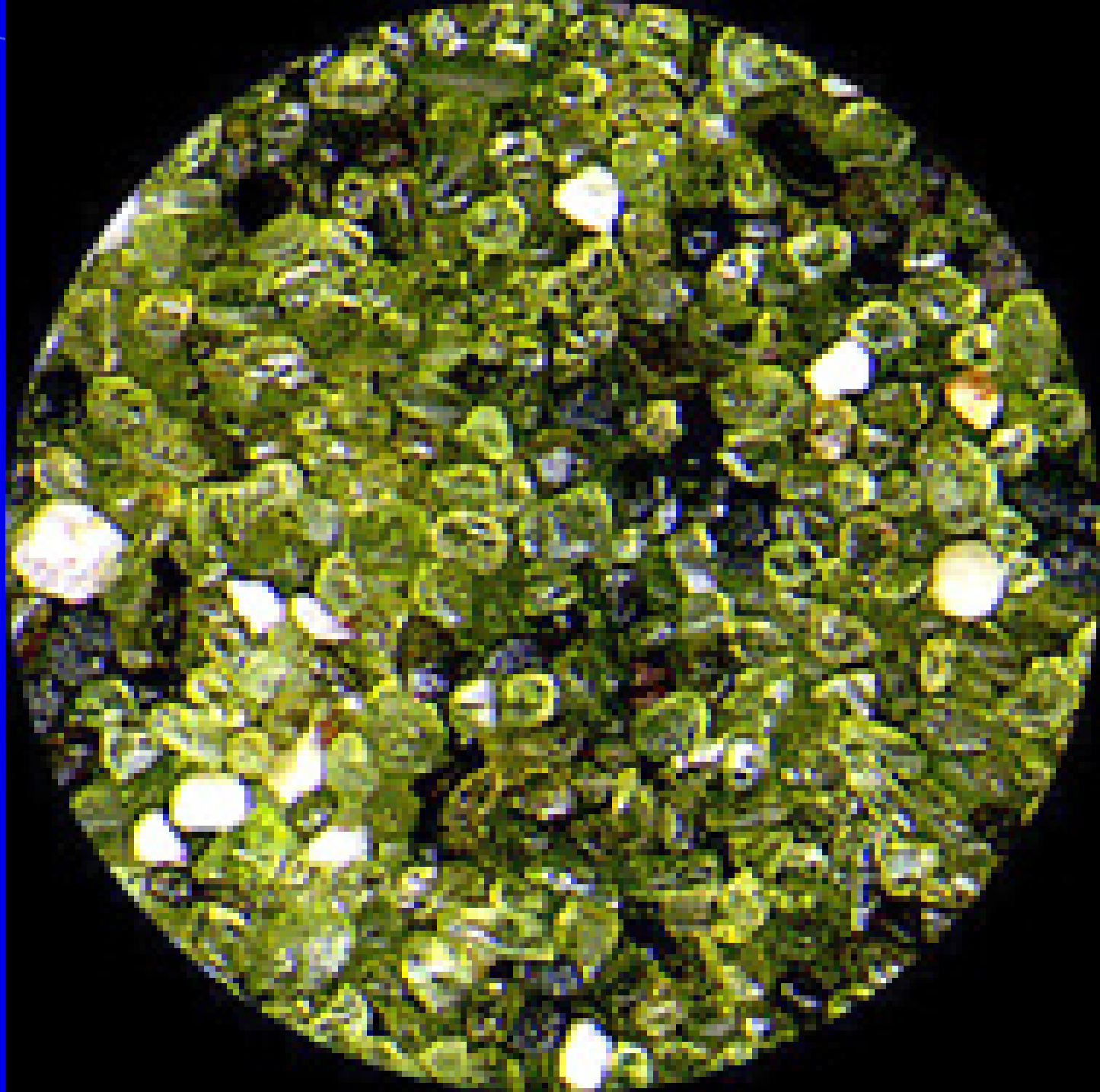
'Standard deviation' = 1.0



'Standard deviation' = 2.0

**Olivine
Sand,
Hawaii**

**Uniform
size
distribution**



Casino Beach, France

Non-uniform size distribution



Characterizing Properties of Sand

Surface Texture

The surface of a sand grain can vary between being smooth to frosted

- **Smooth surface indicates chemical reaction**
- **Frosted surface indicates wind action**

Frosted St. Peter Sandstone, Midwest, USA















Polished Sand Grains from Key Biscayne, Florida



Characterizing Properties of Sand

Roundness and Sphericity

	Well rounded	Rounded	Sub-rounded	Subangular	Angular	Very angular
Low sphericity						
High sphericity						

Angular Sand Grains from the Jordanian Desert



Spherical Grains St. Peter Sandstone, Midwest, USA



Characterizing Properties of Sand

Roundness and Sphericity

- **Sand is ubiquitous. It makes up most beach and river deposits**
- **Sand is concentrated by selective transport**
- **Sand is left at beaches as the finer clay particles are washed out to sea**
- **A medium sized river takes about a million years to transport a sand grain 100 miles downstream**

Characterizing Properties of Sand

Roundness and Sphericity

- **Transport does not do much to change the roundness and sphericity of the sand grains**
- **Work by Kuenen (1960) has shown that the rounding of sand grains is due almost entirely to wind abrasion and that the sphericity of sand grains is inherited from their original crystal structure**

Desert Sand Storm



Examples of the Use of Sand in Forensic Investigations

1. The Balloons of War

- In the fall of 1944 reports of enemy unmanned balloons carrying fire bombs began to come in from the west coast
- While they were thought to be of Japanese origin, how they were delivered was unclear
- Bags of sand used for ballast were recovered in some locations
- Forensic geologists examined the sand and concluded that it was beach sand from Japan

Balloon-bomb Deaths Net Relatives \$20,000

WASHINGTON, March 2—(A.P.) —The House yesterday passed a bill to pay \$20,000 damages to relatives of six persons killed near ~~By, Ore.,~~ by a Japanese balloon bomb during the war.

The deaths occurred March 5, 1945 when members of a Sunday School class came across the grounded balloon and its unexploded bomb while on a fishing trip. Five children and the wife of the minister died when they tugged at the contrivance.

War-time censorship banned any mention of the balloon-borne bombs at the time.

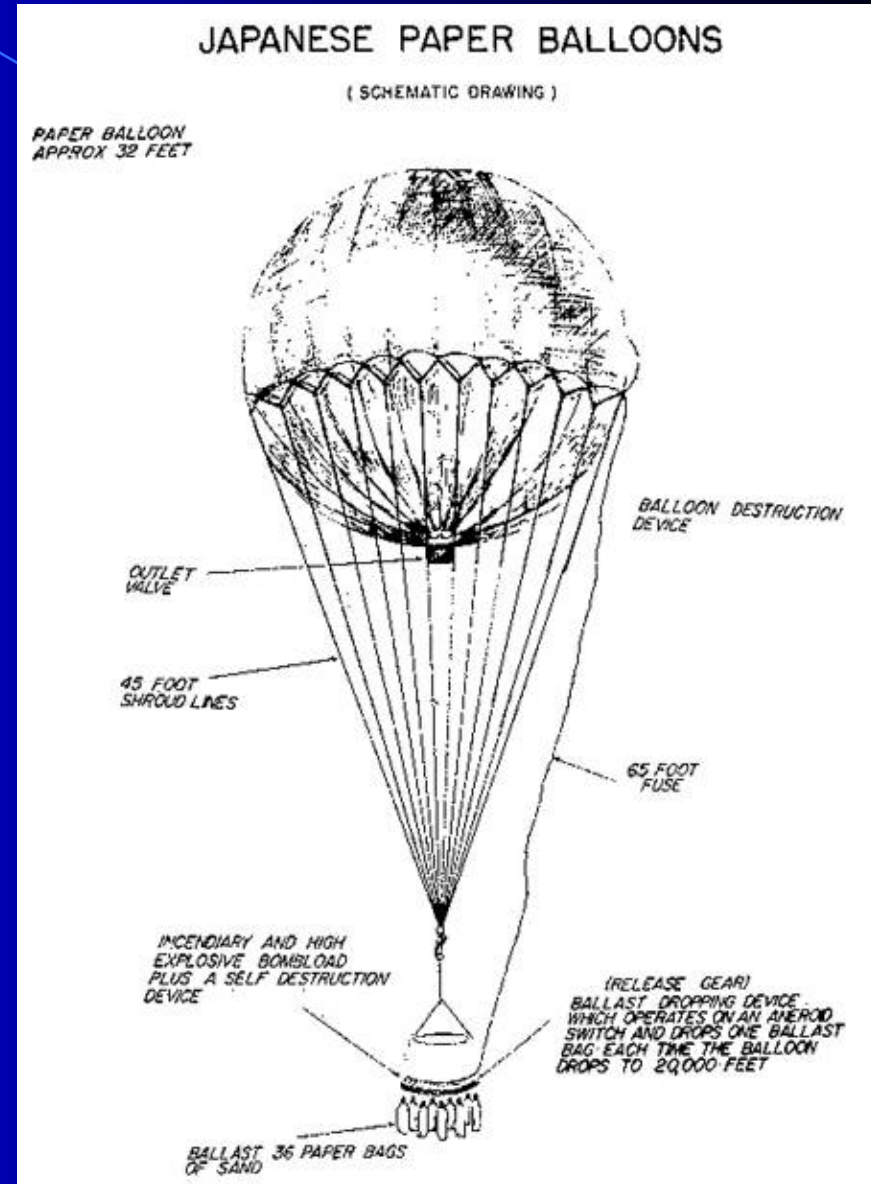
1. The Balloons of War

- **Because no coral was found in the sand it was thought that the location of the beach had to be in the northern 2/3 of Japan**
- **The lack of granite ruled out much of northern Japan**
- **The volcanic mineralogy and microfossils allowed the forensic geologists to suggest two possible beaches**
- **Aerial reconnaissance showed a hydrogen factory and it was immediately bombed**



1. The Balloons of War

- After this no more balloons were found
- In all over 9000 balloons were sent over
- The balloons reached most of the northwestern part of the country, one reached as far east as Detroit
- The only casualties were three members of a Sunday school class that were killed when they came across one on a picnic



2. The Father Patrick Heslin Case

In Colma, California on 2 August 1921 a priest, Father Patrick Heslin, was kidnapped and a ransom note was received, but there was no further contact from the kidnapper. The priest's body was found on a local beach by William Hightower, a master baker. However, sand grains found on Hightower's knife and in his room matched the beach sand at the site where the body was found. Hightower was convicted of the murder and sentenced to life imprisonment in San Quentin. (*Murray and Tedrow, 1992, p. 8*)

3.The Reeves Murder Case

In September of 1958 a woman's body was found at the edge of the Anacostia River in Washington, D.C. A peculiar black sand was found on the victim, in a suspects car, and at the murder scene.

Geologic investigation showed that the sand was blast furnace slag that had been spread on a small section of highway to test it for use in the control of snow and ice. (*Block, 1979, p.149-152*)



4. Sand from a Construction Site

In another example, in southern Ontario a man was arrested and charged with the beating death of the young girl. The scene of the crime was a construction site adjacent to a newly poured concrete wall. The soil was sand that had been transported to the scene for construction purposes. As such, the sand had received additional mixing during the moving and construction process and was quite distinctive. The glove of the suspect contained sand that was similar to that found at the scene and significantly different in composition and particle size from the area of the suspect's home. This was important because the suspect claimed the soil on the gloves came from his garden. (*Murray and Tedrow, 1992, p. 16*)

5. Commercial Foundry Sand

- In a breaking and entering case at a foundry in Toronto, Canada a suspects shoes had grains of olivine sand
- Sands of heavy minerals, olivine, zircon, etc. are used in foundry work
- Because olivine sand is not found in place in that part of Canada the sand on the shoes indicated that the suspect had been at the foundry
(Murray and Tedrow, 1992 , p. 79)

