VOLCANOES – SOURCES AND TYPES OF LAVA

JOE REILLY: We need to investigate the Earth's interior to discover where lava comes from in the first place.

DAVE SHERROD: The Earth is very big, and as you go down inside it, the pressure of the overlying rocks prevents melting. So we don't have melting deep in the Earth, we have heat. As heat comes closer and closer to the surface of the Earth, we're able to produce melts. What depth?
Well, we've got to get pretty high in the mantle, up near the mantle/crust Boundary, before we get pressures that are reduced enough for melting to occur.

BRITT ARGOW:
This melted rock is magma, and it begins to rise towards the surface.

SHERROD: Well, if you believe in gravity, why would magma go up to the surface in the first place? Why doesn't it stay down in the Earth where it belongs? And the problem there is buoyancy. These melts form at depths of 100 kilometers, we think – the seismic evidence suggests they're initiating from that deep – but they're hot melts, and they're able to rise within their semi-plastic surroundings because they're buoyant, they're hot, they actually have lower density than the adjacent wall rocks. So they are following the law of gravity, but that law tells them to rise. "Go to the surface, young lava flow."

ARGOW: Melted rock, or magma, is less dense than solid rock. Because it's less dense, it's more buoyant than the rock around it, and it rises towards the surface. At some point, the magma reaches a depth where its density is close to that of the rock that surrounds it, so it stops rising, but more and more magma is moving up into the crust. This reservoir of accumulated magma is known as a magma chamber. But how does the magma finally erupt? One answer has to do with dissolved gases in the magma.

SHERROD: Heat brings magma up near the surface of the Earth, but it's gas that allows it to erupt because the gas wants to expand. These melts form, they're full of gas, and they're kind of into a neutral buoyancy zone where they might be happy just lodging themselves in the crust, but that gas now starts to expand because the pressure's been reduced enough so the water vapor inside there, the carbon dioxide, the sulfur, they start to increase their volume and cause some of the melts to actually expand or froth.

ARGOW: Magma contains gases like water vapor, carbon dioxide, and sulfur dioxide. As new magma enters the chamber, the chamber swells. Eventually, the overlying rock might fracture from the pressure. The sudden release forces gases out of the magma. Escaping gases froth the magma, making it light enough to rise and causing it to fountain, or explode, when it reaches the surface.

MICHAEL MANGA: A good analogy might be what happens when you open a can of soda or a bottle of soda. There's carbon dioxide dissolved in that soda, and as you open the top, the pressure decreases, which is equivalent to magma coming towards the surface. And you form little bubbles in your soda, just as you form little bubbles in liquid rocks. And then you get a violent explosion. In the case of Mt. St. Helens, that magma was moving up, it started to bulge the mountain, and one part of the mountain caved away, uncorking a gas-charged body of magma. And that gas, all the little bits of gas hidden in there, wanted to expand abruptly, and they just literally shattered the Mt. St. Helens magma body and sent ash across much of the Western United States, caught by the winds and blown east.

ARGOW: Lava was forced so quickly into the air by the depressurizing gases that it shattered apart into billions of tiny particles of ash.

CHUCK BLAY: What happens when the stuff goes sky high? Molten material rock is thrown high into the atmosphere, it cools, and as it settles back down, it's basically ash, which is like a volcanic sand--or big bombs or gravel--but it's no longer a liquid molten material. If you pile up that kind of material, you're going to get a steep side. It's just like if you took a handful of sand on the beach and let it run through your hand, you're going to end up with a little mound. It's going to look like a little volcano mound.

ARGOW: Classic stratovolcanoes are built by episodic eruptions. The initial violent eruption of ash is followed by less explosive eruptions of lava that coat the pile of ash and debris. This sequence of ash and lava eruptions is how stratovolcanoes are built. Even today, small amounts of lava are still erupting at Mt. St. Helens and are beginning to rebuild the summit cone. But not all volcanoes are built in this manner.

SHERROD: All of the Hawaiian islands are volcanic in origin. They're built of almost nothing but lava flows stacked one on top of the other, rising from seafloor depths to the surface. In the case of Kilauea, our 20-year-old eruption that's ongoing now, its early days were high fountains, spectacular fountains, and those jets went as high as 1,400 feet in the air.

ARGOW: Dissolved gas in the magma was responsible for propelling these huge fountains of lava into the air. But there was not enough gas to cause the explosive eruption and generate the volumes of ash that we saw at Mt. St. Helens. At Kilauea, once the initial gas escaped, what started as a dramatic fountaining eruption turned into a more gentle, flowing, effusive eruption. Today, lava slowly advances over the landscape. As it hardens, it creates a large, broadsided volcano known as a shield volcano, named for its resemblance to an ancient warrior shield.