Nested cinder cones developed as the eruption migrated with diminishing intensity along a rift at Craters of the Moon National Monument in Idaho.
Viewing Stereo Images

The two small pictures at the top of each page are a stereo pair. To see the image in three dimensions, you need to look at the right image with the right eye and the left image with the left eye. To do this, pick out some prominent feature in the pictures and stare beyond the pictures. The two prominent features, one from each picture, should float together in the center. This center image will be in three dimensions. At first it may not be in focus. You are accustomed to associate convergence of your eyes with focus. If you continue to stare at the center image, your mind will ultimately relent and focus on the center image while your gaze remains parallel, each eye looking at its respective image.

A simple exercise may help prepare you for this unaccustomed way of viewing. With your hands at arm’s length in front of your eyes, touch your two index fingers together as you look beyond them. You should see a sausage image between your two index fingers. Your eyes are parallel, the right one looking at the right finger, the left one at the left finger. The two images have floated apart, the right one to the left and the left one to the right to form the sausage. The feeling in your eyes is the one you should try to imitate when looking at the stereo images. Some will master the technique instantly. It will take longer for others. If you don’t succeed at first, keep trying at odd times. Try sometime when you are really tired and tend to see double images anyway when you stare at objects. If I could learn to do it, anyone with two good eyes can. I worked at it off and on for over two years before I suddenly learned the knack.

Your eyes are just a few inches apart. With that small separation, you can see in three dimensions for about 1100 feet. Most of these images were taken from a small airplane flying at a velocity of about 100 mph. The interval between the two images varied from one second to several seconds, giving an effective eye base of between 100 and several hundred feet. With this eyebase, you can see in three dimensions for miles. These pictures produce spectacular three dimensional views not easily obtainable in any other way.
Basalt Volcanism

Basalt crystallizes from magma that has risen through the crust from the earth's upper mantle. It tends to be hot, thin, and fluid. Usually, it accumulates in shallow magma chambers in the crust before erupting at the surface. While it is accumulating in the shallow chamber, its lighter factions rise to the upper part of the chamber where the highly gas charged magma exerts more and more pressure against the overlying crust until it explodes to the surface. Expanding gases blow the magma apart and pulverize rock lining the vent to send ash clouds high into the atmosphere. Sometimes, high-speed ground-hugging surges plaster hot ash and mud on the surrounding countryside. Bright red fire fountains spew less explosive gas-charged lava from a few feet to several thousand feet above the vents. The lava that rains down from the fire fountains flows downhill away from the vent in molten streams and fingers. The surfaces of the fingers crust over to form lava tubes that can conduct molten lava within them for miles with little loss in temperature. If the magma loses much of its gas before arriving at the surface, it may accumulate in a lava lake whose level fluctuates with pulses in the eruption and with overflow or discharge into lava tubes.

Explosive eruptions typically produce cinder cones made of loose and porous piles of ash, cinders, lapilli, and bombs, collectively known as tephra. Because the tephra is so permeable, little gully development takes place on the cones until the material weathers enough to form a soil. Most basaltic cinder cones are less than several hundred feet in height, perhaps because by the time they have grown that high, most of the highly explosive gas-charged lava has been expended. If the rising magma has access to large volumes of water, the eruptions are even more explosive as the water flashes to steam. In steam-permeated tephra, silica is leached from the minerals and reprecipitated as cement between the particles as they accumulate, to form tuff. Tuff cones have larger craters than cinder cones, and runoff quickly incises gullies into their soft impermeable flanks.

Hot, plastic clots of lava that fall from the margins of fire fountains splat and weld themselves together around the vent to form spatter cones.

Quiet effusions of lava build up shield volcanoes around the vents as their lava lakes overflow. Because basaltic lava flows so readily, the slopes of shield volcanoes tend to be gentle. When the magma withdraws and the eruption stops, a pit crater or pit caldera is left at the top of the shield. Calderas are distinguished from craters in being larger depressions, more than one mile in diameter.

Characteristic features and structures produced by basaltic volcanism are illustrated in this booklet by greyscale stereo photos taken in Ecuador's Galapagos Islands, Idaho's Snake River Plain, and Iceland.
You are looking at a crater lake in a tuff cone on Isla Isabela in the Galapagos Islands of Ecuador. The layers of tuff that make up the cone have been exposed by phreato-magmatic explosions that enlarged the crater. Sea water percolates through the porous tuff to form the lake in the crater. December 17, 1982.
You are looking at the outside of the tuff cone containing the crater lake on Isla Isabela in the Galapagos Islands of Ecuador. The inclined layers in the tuff cone have been exposed by wave erosion. December 17, 1982.
You are looking at interbedded stratified (air fall) tuffs and unstratified and unsorted cold lahars (mudflows) outcropping along the side of Tagus Cove, Isla Isabela, Galapagos Islands, Ecuador. The bird, posing for scale on the lowest ledge of tuff, is a blue-footed booby. December 17, 1982.
The gentle cross stratification of this tuff may have been produced by the high velocity flow of an ash laden cloud, the basal surge of an eruption column that collapsed. December 17, 1982, Tagus Cove, Isla Isabela, Galapagos, Ecuador.
A basalt lava flow filled a valley cut into stratified tuff on the side of Tagus Cove in Isla Isabela of the Galapagos Islands of Ecuador. December 17, 1982.
Spatter cones are aligned along a rift that follows the crest of Isla Isabela in the Galapagos of Ecuador. They are made of spatter that fell out of the fire fountains that gushed from vents along the rift. The stratified layers of a cinder cone can be seen in the crater to the left of the spatter cones. December 17, 1982.
The fragments of incandescent spatter from a fire fountain welded together where they fell adjacent to the vent to form this spatter cone along the crest of Isla Isabela in the Galapagos Islands of Ecuador. December 17, 1982.
Fire fountains of incandescent lava, squirting high above their vents in these spatter cones, cascaded back to earth to flow away as lava flows on Isla Barthsolome in the Galapagos Islands of Ecuador. December 18, 1982.
The sea-like surface of this pahoehoe basalt flow froze in 1897 near Sullivan Bay on Isla Santiago in the Galapagos Islands of Ecuador. The xenolith is a chunk of palagonitic scoria torn from a cinder cone as the flow passed by. Palagonite is basalt that has been weathered in the presence of water to form iron oxides and chlorite from its ferromagnesian minerals. December 18, 1982.
Three kinds of pahoehoe are displayed on the surface of the 1897 lava flow near Sullivan Bay on Isla Santiago in the Galapagos Islands of Ecuador. They are billowy pahoehoe, ropy pahoehoe, and entrail pahoehoe, the last named for its resemblance to intestines. Pahoehoe forms on the surface of the hottest and most fluid lava flows. December 18, 1982.
In 1897 near Sullivan Bay on Isla Santiago in the Galapagos Islands of Ecuador, a small log surrounded by hot lava burned out to leave this mold and the impression of its bark on the basalt. December 18, 1982.
Steam, generated by heat as the molten basalt covered a wet spot or marsh, blew out bits of congealed basalt as spatter to build these two small hornitos on the surface of the flow. December 18, 1982.
Gas bubbles rising through the molten basalt blew a pit in the congealed skin on the top of an 1897 flow near Sullivan Bay on Isla Santiago in the Galapagos Islands of Ecuador. December 18, 1982.
Ropy pahoehoe wrinkled the leathery crust of the new basalt as the basalt beneath flowed downhill away from the observer to deform the "ropes" into convex arcs that point downflow. The surface then arched up into a pressure ridge and cracked as it was jostled first one way and then another by the changing flow underneath. This is part of the 1897 basalt flow on Isla Santiago near Sullivan Bay in the Galapagos Islands of Ecuador. December 18, 1982.
A small tongue of basalt from the 1897 flow spilled through a gap in the flank of a palagonitic cinder cone. It ends on palagonitic lapilli and cinders on Isla Santiago near Sullivan Bay, Galapagos Islands, Ecuador. December 18, 1982.
Incandescent clots of lava sprayed out by a fire fountain welded themselves to one another where they fell next to the vent to form this spatter cone. They have since turned brown as they weathered into palagonite. The flank of a palagonitic cinder cone occupies the background near Sullivan Bay on Isla Santiago in the Galapagos Islands of Ecuador. December 18, 1982.
Isla Fernandina, the southernmost, youngest and most volcanically active of the Galapagos Islands, is a shield volcano whose flanks steepen toward its broad summit. Its cloud-covered top is occupied by a pit caldera. During some eruptions, the lava that overtops the rim of the caldera flows only short distances down its flanks. Other eruptions produce flows that travel farther. All tend to build up the rim area, increasing the steepness of the shield there. December 17, 1982.
The arcs of ropy pahoehoe point in the direction of flow because the center of the lava stream flowed faster than its edges. This part of the lava flow, which is along its edge, was subsequently arched upward and cracked by the pressure of the lava behind it. The large crack runs along the crest of the pressure ridge. Isla Fernandina, Galapagos Islands of Ecuador. December 17, 1982.
As the lava drained out of the lava tube beneath this hot pahoehoe flow, its roof collapsed. In the distance it is covered by an aa flow. Isla Fernandina, Galapagos Islands, Ecuador. December 17, 1982.
Part of the surface of this pahoehoe flow remains as a bridge across the top of a lava tube while most of the rest collapsed as the molten lava drained out of the tube. Pahoehoe forms on the surface of the hottest and most fluid of the basalt flows. Farther from its source as it cools and becomes a bit less fluid, the pahoehoe may break up into disrupted pahoehoe. Still farther out, the cooler and more viscous lava may break up into the chaotic and spiny surface called aa. Isla Fernandina, Galapagos Islands of Ecuador. December 17, 1982.
The edge of a jumbled and spiny aa flow advanced over a pahoehoe flow on Isla Fernandina, Galapagos Islands of Ecuador. December 17, 1982.
You are looking toward the northeast at the dry falls of Grand Coulee in central Washington. The Okanagan Lobe of the glaciers that descended from Canada diverted the Columbia River through Grand Coulee to carve these falls as it plunged over the eroded edge of the basalt flows. Glacial floods probably also tumbled over these falls in giant cataracts when the Spokane Lobe ice dam at Lake Pend Orielle broke and the waters of glacial Lake Missoula rushed southwestward across central Washington. The dry waterfalls expose the basalts of the Columbia Plateau. Many of them issued in huge volumes sporadically from the suture zone between the Washington-Oregon microplate and the western edge of North America in western Idaho. They flooded westward across Washington and Oregon as flows, some up to 300 feet thick, over an approximate five million year span in the mid Miocene, about 17 million years ago. These hot voluminous floods of basalt may total as much as 35,000 cubic miles. September 5, 1975.
Like a fiery torch, the Yellowstone hot spot burned its track across Idaho as North America drifted over a plume of magma rising from the earth’s mantle. White labels show the locations of volcanic features shown on succeeding pages.
This pahoehoe flow on the Snake River Plain southwest of Idaho Falls contains sink holes that formed when the lava drained from under the skin of pahoehoe to fill an expanding finger at a lower elevation. These flows expanded slowly across the countryside in contrast to the high effusion rates of the huge volume flows of the Columbia Plateau. August 17, 1981.
You are looking toward the southeast along the rift zone that extends from the Craters of the Moon volcanic field at the northwestern edge of the Snake River Plain to the King’s Bowl near its southeastern corner. Flexing cracks developed as the area alternately inflated and deflated as lava rose and subsided along the rift. Lava flowed out of the rift to form lava lakes. Some of this lava also flowed back down into the rift as the eruption subsided. Most pit craters formed by collapse as lava withdrew from shallow magma chambers under the rift. King’s Bowl pit crater also formed from an explosion of steam generated from ground water heated by the lava under an area of the rift that was sealed by sheet dikes left along the faces of the rift by repeated outflows of lava. August 17, 1981.
You are looking toward the southeast along the rift zone at King's Bowl on the southeastern Snake River Plain in Idaho. Congealing lava was pushed up by the pressure of the expanding lava lake to produce lava mounds that formed natural levees around the lava lakes. Three separate outpourings of lava formed the lava lakes adjacent to the King's Bowl. A veneer of ash from a steam explosion at the King's Bowl pit crater covers the surface of the youngest lava lake on the northeastern side of the rift. Prevailing winds from the southwest blew the ash to the northeast. August 17, 1981.
You are looking toward the southwest across the King's Bowl Rift. Flexing cracks that formed as the area along the rift alternately swelled and subsided with each outflow of lava are well shown in the foreground. The buildings in front of and to the right of King's Bowl pit crater are the headquarters for “Ice Cave” tours to look at giant icicles down in the rift. In winter cold air sinks into the rift and freezes the ground water that drips into the rift. In summer the dense cold air tends to remain in the rift, preserving the icicles. August 8, 1996.
You are looking at two pit craters at the tops of two small shield volcanoes on the southeastern Snake River Plain in Idaho. The pit crater in the foreground shows two episodes of activity. A terrace is a remnant of its earlier lava lake floor that formed when the lava that overflowed to form the small shield volcano withdrew. The summit of the little shield collapsed to form the outer pit crater with a lava lake in it. The surface of the lava lake congealed and then partially collapsed as the lava withdrew again to form the inner pit. June 18, 1982.
You are looking across the pit crater at the top of Black Butte shield volcano in south-central Idaho. After the surface of the lava lake had solidified to form a flat floor about half way toward the top of the volcano, molten lava withdrew from under it in the foreground, causing it to break up and subside. The edges of lava flows that formed the shield are exposed in the walls of the pit crater. August 9, 1996.
A spatter bomb blown out of the lava lake welded itself to the surface of this lava flow near the edge of Black Butte's pit crater on the Snake River Plain in south-central Idaho. The pocket knife is 2 1/2 inches (65mm) long. August 9, 1996.
Two rhyolite bomb xenoliths lie in this field of scoriaceous basalt bombs on the upper flank of Black Butte near its pit crater on the Snake River Plain in south-central Idaho. The pocket knife is 2 1/2 inches (65mm) long. August 9, 1996.
Red hot molten lava surged over the irregular floor of this deep channel to supply lava to the Shoshone Lava Field from the pit crater at the crest of Black Butte on the Snake River Plain in south-central Idaho. August 9, 1996.
You are looking along a lava channel eroded into aa lavas on the flank of Black Butte Volcano. The lava stream that eroded the channel left a thin irregular lining of basalt on the floor and flanks of the channel. Black Butte is located on the Snake River Plain in south-central Idaho. August 9, 1996.
This apparent small vent on the flank of Black Butte Volcano may have been fed by a lava tube, and may actually be a lava blister arched upward by a small laccolithic intrusion. The brittle basalt over its top appears to have collapsed as the magma withdrew from beneath it, leaving a vent-like depression filled with angular rubble. A closer view is shown on the next page. August 9, 1996.
You are looking across the small vent or collapsed lava blister on the side of Black Butte that is shown in more distant view on the previous page. Because the interior of the depression is filled with angular rubble instead of congealed lava from a lava lake, and because there is no place where lava can be seen overflowing the walls of the depression, it seems likely that it may be a collapsed lava blister rather than a vent. Picture taken August 9, 1996.
You are looking toward the northwest along a part of the rift that extends from Craters of the Moon at its northwest end to King's Bowl at its southeast end. Flexure cracks parallel to the main rift result from alternate swelling and subsidence of the rift as magma rises to erupt and withdraws to erupt elsewhere. Picture taken August 17, 1981.
You are looking toward the south at a breached cinder cone at Craters of the Moon National Monument on the Snake River Plain of Idaho. A column of lava that rose in the crater of the cinder cone tore out the side of the volcano to form this pahoehoe flow, rafting pieces of the cinder cone wall (monoliths) with it. Erosion by the flow undermined the flank of the adjacent vent till it became unstable and slid. Picture taken June 18, 1982.
A close view of the flank of the cinder cone shown on the preceding page reveals bombs made of scoria, mostly about fist size. July 1, 1996.
A large broken bomb displays a rim of scoria that is particularly well developed on the top of the bomb, and compressed on the bottom. It surrounds a solid interior containing gas chambers that may have been compressed when the bomb landed. The bomb is about two feet in diameter. July 1, 1996.
The dashed white line partly outlines a huge volcanic bomb on the southern flank of the breached cinder cone at Craters of the Moon National Monument on the Snake River Plain of Idaho. Layers of the cinder cone's flank are parallel to the arrow in the upper right corner of the picture. July 1, 1996.
You are looking toward the northwest at one of the vents for the pahoehoe flow in the breached cinder cone at Craters of the Moon National Monument on the Snake River Plain in Idaho. Fragments of the cinder cone wall (monoliths) were rafted out on the flow when the flow tore out one flank of the cinder cone, probably about 2000 years ago. The main vent for the pahoehoe flow is just to the right of the middle of the picture. Picture taken July 1, 1996.
You are looking toward the southeast at the main lava flow vent of the North Crater pahoehoe flow from the breached Cinder Cone at Craters of the Moon National Monument on the Snake River Plain of Idaho. July 1, 1996.
These monoliths are fragments of a cinder cone wall rafted out on the Devil's Orchard Flow at Craters of the Moon National Monument on Idaho's Snake River Plain. Part of the cinder cone collapsed when lava rose up in the crater and tore a breach in it. Picture taken July 1, 1996.
Billowy pahoehoe marks the surface of the lava flow that breached the cinder cone wall at North Crater in Craters of the Moon National Monument on the Snake River Plain in Idaho. You are looking downstream where the lava poured through the breach. Picture taken July 1, 1996.
Lava squeezed up through a crack in a pressure ridge to congeal as a bulbous mass over the crack, forming a "squeezeup". The lava flow is from the breached crater (North Crater) at Craters of the Moon National Monument on the Snake River Plain of Idaho. Picture taken July 1, 1996.
You are looking down into the hollow where a tree burned out when lava congealed around its trunk in the Blue Dragon Flow at Craters of the Moon National Monument on the Snake River Plain in Idaho. Picture taken July 1, 1996.
A small stream of lava cascaded into the burned out mold of a log rafted on the Blue Dragon Flow in Craters of the Moon National Monument on the Snake River Plain in Idaho.
Molten lava from the lower part of the Blue Dragon Flow arched the congealed lava on the top into a blister before withdrawing as the top of the blister collapsed.
You are looking toward the south at the northwest end of the rift that extends across the Snake River Plain from King's Bowl on the southeast to Craters of the Moon. A succession of cinder cones migrated toward the southeast along the rift during the explosive phase of an eruption to form the nested cones at Craters of the Moon. Spatter cones were built by fire fountains that supplied lava flows extending to the southwest from the rift. Picture taken August 17, 1981.
The most powerful explosions blow the lava into the smallest pieces (ash). Less powerful explosions produce cinders (sand size), lapilli (walnut size), and bombs (bigger than walnuts). The layers exposed on the crater wall result from variations in the explosions. You are looking at the inside of one of the nested series of craters at Craters of the Moon National Monument in Idaho. Picture taken July 1, 1996.
Lapilli (about walnut size) and small bombs (larger than walnuts) form crude layers on the flank of North Crater at Craters of the Moon National Monument on Idaho's Snake River Plain. The pocket knife is 2.75 inches (7 cm) long.
A lava flow several feet thick and a few hundred feet wide poured down the southwestern flank of Big Crater to become interbedded with thepra (fragmental volcanics). Big Crater is near the southeastern end of the series of nested craters at Craters of the Moon National Monument on Idaho’s Snake River Plain.
You are looking toward the northwest along the rift in Craters of the Moon National Monument at spatter cones and nested cinder cones. Spatter cones formed around vents where fire fountains sprayed into the air. Incandescent clots of lava, dropped from the edges of the fire fountains, welded together on impact to form cones made of lava spatter. Picture taken August 17, 1981.
You are looking toward the east from the flank of Big Crater at the spatter cones aligned along the rift in Craters of the Moon National Monument. The picture on the next page shows a close view of the flank of the nearest spatter cone. Picture taken July 1, 1996.
You are looking northwest along the rift in Craters of the Moon National Monument, Snake River Plain, Idaho. Big Crater is one of the nested cinder cones created by a series of explosive eruptions that migrated southeast along the rift. North Crater was breached by a pahoehoe flow at the end of an eruption about 2000 years ago. The northwest wall of the older cinder cone was also breached by a lava flow. The spatter cones were built by fire fountains. Pit craters and a lava blister that has an intact but collapsed roof are visible along the rift toward the bottom of the picture. Picture taken August 17, 1981.
A series of explosions of decreasing intensity migrated to the northwest to produce these nested craters at Craters of the Moon National Monument along the northwestern edge of the Snake River Plain in Idaho. At the end of the eruption a small flow of lava issued from the base of the compound cone, causing a minor landslide of the undermined flank above it.
You are looking toward the north at two tuff cones, Menan Buttes, on the edge of the Snake River floodplain north of Idaho Falls. Basalt magma that rose through water saturated gravels of the Snake River floodplain exploded violently as the water flashed to steam. The violent phreatomagmatic explosions created the large craters characteristic of tuff cones. The steam also saturated the fragmental volcanics that accumulated around the vents. It leached silica from some of the minerals and reprecipitated it between the particles as it cooled, changing the loose tephra into a cemented and more coherent rock called tuff. The resulting tuff cones are not as permeable as cinder cones, and show incision by gullies. Picture taken August 17, 1981.
You are looking toward the north at the northernmost Menan Butte tuff cone. At places around the rim of the crater the layers of tuff dip down into the crater. They probably collapsed into the crater after particularly violent phreatomagmatic explosions toward the end of the eruption. Because they sagged as coherent layers and did not slide as a loose aggregation of particles, it seems likely that they were already cemented to form layers of tuff even before the eruption was over. Picture taken August 17, 1981.
You are looking toward the south at China Cap, a small cinder cone about 1250 feet (385 meters) across. Its crater is about 100 feet (30 meters) deep. It has been surrounded and partly buried by a pahoehoe flow creating the moat where the flow front solidified.* Perhaps the fluid pahoehoe lava soaked into the porous cinder cone to create the moat. The top of a smaller cinder cone protruding from the lava just below China Cap also has a moat around it. Picture taken September 6, 1975.

When basalt is extruded under water, the water pressure may keep it from exploding and at the same time freezes the outer skin of the lava into a leather-like cover. The cover inflates and the pillow of lava rolls down the slope to adjust its flexible skin to others already there. The result is a deposit with pillows that have convex tops and bases that conform to the shapes of the underlying pillows. This picture was taken by Douglas Dresser in Resurrection Bay on the Kenai Peninsula, Alaska in May of 1983.
The North-Atlantic ridge. The ridge-segments are the main rift zone (axial rift zone, thick black lines) and the fracture zones (W-E trending) are fracture zones where the ridge-segments move laterally, relative to each other. (Simplified after Schützbach, 1976)

The fissure- and volcanic systems in Iceland.

**Cormháin & Kjarðarson**, "Guide to the Geology of Iceland", 1984

The first phase of a sub-glacial eruption. Formation of pillow-lava.

The second phase of a sub-glacial eruption. The cauldron in the ice is filled up with tephra.

The third phase of a sub-glacial eruption. Production of lava.
A geological map of Iceland. The three main formations are: The Tertiary Plateau basalts prior to the Ice Age; older than 3 mill. years (brown); - The Plio-Pleistocene rocks from the early Ice Age; 0.7 - 3 mill. years old (orange); - The late Pleistocene palagonites and lavas and Holocene rock; younger than 0.7 mill. years (grey) (Sverrir Ólafsson)

Geopunkdesign / Kartirænasen "Geology of the Grunden in Iceland" 1984
You are looking northward across Hammar Fiord on Iceland's eastern coast. Pliocene-age basalt flows, tuffs and mudflows dip toward the east, toward the fissures from which they sprang. On Iceland's west coast, the volcanics mostly dip eastward, again toward the vents along the Mid-Atlantic Ridge. Has the crest of the Mid-Atlantic Ridge across Iceland collapsed, or are the coastal areas being raised and tilted by upwelling convection currents on either side of the Ridge?
Columnar joints propagated into each basalt flow as the lava cooled and shrank, a plane of shrinkage migrating from the base upward into each flow. Radiating columnar joints probably formed where the lava flow encountered glacial ice. Columnar joints are perpendicular to the cooling surfaces. Picture taken June 18, 1984 near Kirkjubaejarklaustur in southern Iceland.
The finely jointed part of the basalt flow above the columnar joints is called the entablature. A mudflow may occur above the lava flow. Its massive character and scoured base are in harmony with its interpretation as a mudflow. Picture taken June 18, 1984 east of Kirkjubaejarklaustur in southern Iceland.
The creek has exposed a columnar-jointed dike west of Statharborg in eastern Iceland. Picture taken June 19, 1984.
Columnar joints at the base of a basalt flow near Hvalfiord in western Iceland show chisel marks and plumose structure. Chisel marks are the flat facets that extend across the columns. Each facet is a separate break formed as the columns grew upward into the cooling flow. The irregularities along the sharp edges between faces of the columnar joints result from the chisel marks breaking at slightly different angles as they grow upward into the flow. The flaring marks on the surfaces of the chisel facets is plumose structure. It forms as the chisel facets break. Because the break starts at the base and extends upward, the plumose structure flares upward onto the face of the chisel mark from tangent to its base. Picture taken June 25, 1984.
You are looking toward the west across the aa surface of one of the lava flows that sprang from the Laki Fissure in 1783. The Laki Fissure cut a path about 25 km in length across south-central Iceland. The eruption began on June 10, 1783 and lasted until the beginning of February, 1784. More than 100 vents produced ash, fire fountains and lava. The lava alone covered 565 square kilometers of land with an estimated volume of 12 cubic kilometers. It filled and overflowed two canyons 500 km deep and spread out on the plains of southern Iceland, as seen here. Sulfur dioxide fumes and fluorine from a bluish haze stunted grass over the whole island and created a famine that claimed 24 percent of the population. *

The surface of this aa flow is wrinkled into pressure ridges by the drag of the lava flowing beneath the congealing crust. The ridges are aligned transverse to the flow of the lava and tend to be warped into arcs that are convex downflow because the center of the lava flow moves faster than the edges. North-central Iceland near Leirhnjukur. Picture taken June 20, 1984.
As this lava flowed over swampy ground, water flashed to steam, blowing out clots of lava that plastered together around the vents to form hornitos, also called pseudocones in Iceland. Picture taken south of Husavik of the Athaldalshraum (name of the lava flow) on June 21, 1984.
A close view of two hornitos on Athdalshraum shows the clots of lava (spatter) that accumulated around the vents of these rootless spatter cones. They are about 5 feet (1 1/2 meters) high. Picture taken June 21, 1984.
As basalt flowed over marshes and ponds along Iceland's southern coast, water flashed to steam, blowing out clots of lava that plastered together around the vents to form the rootless pseudocones (hornitos) strewn across the undulating surface of this lava flow. Picture taken near the Skala River on June 16, 1984.
The volcanoes erupted explosively along a rift under an ice cap during the Pleistocene. They melted holes through the ice, much of the water mixing with the ash, cinders, and lapilli to produce palagonitic mudflow breccias. This area in northern Iceland is known as a hill garden, the Mothrudals Fjallgarthur. Picture taken June 20, 1984.
This picture was taken while standing on the flank of one volcano and looking across the road at another along the rift at Mothrudals Fjallgarthur in northern Iceland. The surfaces of the volcanoes consist largely of tuff breccias, some parts more indurated than others. The tuff breccias are shown in closer view on the next page. Picture taken June 20, 1984.
Close view of tuff breccia on the flank of a volcano that erupted through an ice cap during the Pleistocene in northern Iceland along the Mothrudals rift zone. The pencil is about five inches (12.5 cm) long. Picture taken June 20, 1984.
You are looking south at the volcano Herthubreid in north-central Iceland. The eruption that built this table mountain took place under an ice cap that covered Iceland during the Pleistocene. The initial eruption domed the ice cap, finally melting a hole through the ice. Initial extrusion under the ice produced basalt pillows followed by explosive eruptions of tephra through the lake within the hole in the ice. Meltwater reacted with the pillow lava and the tephra to form palagonite. Once the volcano built its edifice above the meltwater, basalt lava flows poured out of the vent to form a cap within the ice hole on top of the palagonite tuffs.*

Vindbelgjafjall is an andesitic volcano in north-central Iceland near Myvatn. Andesites and rhyolites erupt to the surface only after a long period during which the denser less silicic minerals crystallize and settle out of the magma underlying the volcano. The lighter more silicic minerals that make up andesites and rhyolites are thus concentrated in the upper part of the magma chamber, ready to erupt explosively in a viscous magma. Picture taken June 20, 1984.
You are looking toward the north at a rhyolite volcano bordering cloud-covered Oraefajokull in southern Iceland. Three tilted terraces at the base of the volcano record isostatic rebound as Oraefajokull's ice has melted. Oraefajokull is a satellite ice cap bordering Vatnajokull on the south. Picture taken June 18, 1984.
You are looking toward the northeast across outwash deposits (sandur) at outlet glaciers from Oraefajokull in southern Iceland. When volcanoes erupt under the ice cap, huge volumes of meltwater discharge from beneath the glacier to cover the entire sandur to depths of several feet. These outburst floods, called Jokuhlaups, may have immense discharges, rivaling those of the world's largest rivers. Picture taken June 18, 1984.
You are looking toward the southeast at boulders, probably dropped by a jokulhlaup from a subglacial eruption under Vatnajokull, Iceland's largest ice cap. It covers the volcanoes north of this volcanic escarpment. Picture taken June 18, 1984.
You are looking toward the southwest at craters along the rift that cuts 800 year old rhyolite domes of Tarawera Volcano near Rotorua on New Zealand's North Island. Basaltic magma exploded as a dike intruded into the rift at 2:10 a.m. on June 10, 1886, sending an eruption cloud 30,000 feet above Tarawera. Rotomahana Lake blew out at 3:20 a.m. blasting a column of ash and mud over seven miles high and sending hot pyroclastic surges of mud and ash over the tops of hills 1100 feet above the lake. Eruptions continued from the entire 10-mile length of the rift until 6:00 a.m., raining ash and mud over a large area. The pyroclastic surges killed 108 people in seven villages.*