Craters!
Living in an Impact Zone

Craters formed by meteors striking the Earth are called *impact craters*. Volcanoes also create craters but these are called *volcanic craters*. The name *caldera* is also used to describe volcanic craters.

Impact craters are formed when a meteors strikes the Earth's surface at speeds of many kilometers per second. The meteor that created the Manicouagan Crater in Quebec was probably traveling at about 60 kilometers per second. This high-speed impact results in a large explosion that *vaporizes* the meteor and sprays material from the Earth into the surrounding area. The material sprayed out is called *impact ejecta* which is just a fancy way of saying the stuff *ejected* (thrown out) by the impact. This impact ejecta may spread over a region many times larger than the size of the crater. The Barringer Crater in Arizona is about ¾ of a mile in diameter yet the impact ejecta can be found as much as 5 miles away! However, most of the material lands very nearby and is what forms the *crater rim*.

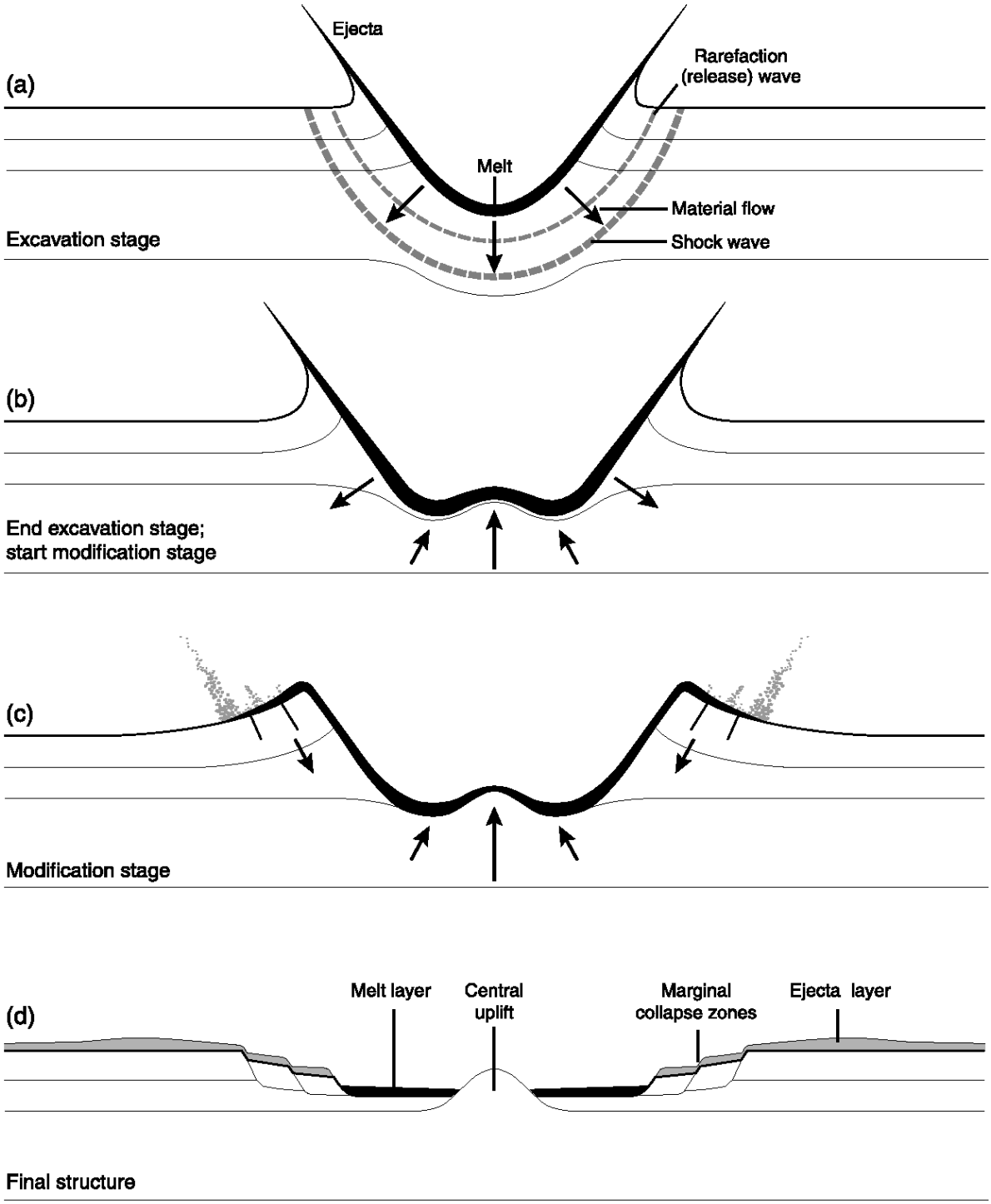
Impact craters can be put into two groups: *simple craters* and *complex craters*.

Simple craters have a crater rim and a simple bowl-shaped interior. The *formation* of a simple crater has only one *stage* or step called the *excavation* stage. In this stage, the meteor hits the Earth and *excavates* or digs out the hole just from the force of the impact and explosion.

Complex craters also have a crater rim, but the inside edges of the rim may be slumped inward as if they have collapsed a little. Instead of a simple bowl-shaped interior, the floor of these craters is nearly flat and there is a *central uplift* area; that is, there is a small peak in the middle, almost like a water-drop splash frozen in time. The formation of a complex crater has four steps. The first step is also the excavation stage, just like for simple craters. However, complex craters are formed by larger meteors and so the process does not stop here. Because the meteor is larger and the force of the impact is larger, the Earth underneath the impact is *compressed* or squeezed more than is normal. In the second step, which begins what is called the *modification* stage, this *compression* or squeezing is released and the ground directly under the impact bounces back or *rebounds*. The rebound results in a part right in the middle that rises up and forms what is called the *central uplift* which is just a fancy name for the small hill that is formed in the middle. The third step continues the modification stage with a process called *downward faulting.* When the meteor strikes the Earth, the region all around the impact gets cracked much like what happens when you strike a clay tile with a hammer. These cracks, or *faults* which are near the edge of the crater slump downward into the crater which caused the height of the crater rim to decrease. At the same time this is happening, the material thrown out by the impact, the *ejecta*, is continuing to fall building up the crater rim. In the fourth and final step, the material melted by the heat generated by the impact settles in the crater floor. Because the melted rock is somewhat *fluid* (that is, it flows like a very thick liquid), it tends to level out the floor of the crater.

Meteors come in all sizes and so do the craters they form. However, on Earth, small craters usually *erode* or wear away due to *weathering* caused by repeated rain, freezing, and so on. This *erosion* can cause small craters to disappear in only a few thousand years. Also, since about 70% of the Earth's surface is covered with water, small meteors simply cause a big splash and nothing more. But big meteors, like the one which helped kill off the dinosaurs 65 million years ago, will punch right through the ocean until they hit the sea floor below. The Chicxulub crater formed by this dinosaur-killer is 180-kilometers wide and struck the ocean off the coast of the Yucatan peninsula which is part of Mexico.

The size or an impact crater is determined mostly by two things: the kind of material which is hit (but not the kind of material the makes up the meteor) and gravity. The moon is composed of rock very similar to much of that found on the Earth's crust. But the same size meteor, traveling at the same speed, would leave a very different sized crater on Earth and the Moon because of the different gravity. You might think that only meteors which impact traveling straight down would leave circular craters but that's not true. Craters are almost always circular. The only exceptions are when a meteor strikes the surface at a very shallow angle, much like when you skip a stone across a pond. At those shallow angles, the crater may be *elliptical* or *elongated*.



French B. M. (1998)
Traces of Catastrophe: A Handbook of Shock-Metamorphic
Effects in Terrestrial Meteorite Impact Structures.
LPI Contribution No. 954,
Lunar and Planetary Institute, Houston. 120 pp.