anatomy of an avalanche

what triggers a slide?

BY MARK RIKKERS AND AARON RODRIGUEZ

WHEN SIR ISAAC NEWTON DEFINED GRAVITY in 1687, he didn't have avalanches on his mind. His discoveries certainly factor into slides, but there's a lot more to cascading snow than just Newton's universal law. This region's snowpack is one of the most tenuous in North America, but it's not because gravity is fiercer in the San Juan Mountains. Here we dissect the elements and forces at work…

the strongman

Snowpack on an incline is in a constant tug-of-war between stress and strength. Gravity is a stress that increases with slope angle, and the snowpack has its own ever-changing strength. When the strength is greater than the stress, snow stays put; but when the cumulative stress is greater than the strength, something's gotta give. Picture an old-time circus with a flexing strongman. If someone hands him one bag of snow at a time, he can adjust to each one, ultimately supporting an impressive weight. At some point, however, he simply can't take one more bag and collapses. The strongman in this scenario is the snowpack; the bags of snow are the stress.

powder day

Now picture that same strongman without time to adjust to each added weight because a bunch of bags (new snowfall) are loaded onto his shoulders over a short period of time. Without the opportunity to adjust slowly to the new weight, he collapses immediately.

air blast

As an avalanche moves, it displaces the air in front of it. If the slide is large enough, this can create a forceful air pressure wave.

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crown wall

The uppermost boundary of the slide that runs perpendicular to the slope

body types

Avalanches are categorized in two general ways: loose or slab. In loose slides, the snow has little or no cohesion, and a single release point near the surface causes the avalanche to fan out in the shape of a triangle. Slabs, on the other hand, are a cohesive mass that releases along a failure line, sometimes as deep as ground level, and cut an irregular square or rectangular formation. Slab avalanches are the most dangerous and destructive.

the angle of repose

Every granular material has a different angle of repose. For snow, it's 38 degrees, but avalanches can occur on gentler slopes, depending upon the snowpack's composition and other factors.

the trigger

The balance between strength and stress is fragile. A trigger can easily tip the scale and cause a slide. Triggers come in many shapes and sizes, but often their common characteristic is weight. Snow—either freshly fallen, shifted by wind or deformed by drastic changes in temperature—is a common trigger. But skiers and snowboarders, snowmobilers, snowshoers, animals, etc., can set off a slide. It's important to note that a trigger doesn't have to be at the top of the slide. An avalanche can be touched off from the side, below or even from a remote stress point known as "The Telegraph Effect."

speed & destruction

Some avalanches have been recorded to run at speeds in excess of 200 mph, but the average speed of a slide is usually 60 to 80 mph. The power of an avalanche can be enough to snap mature trees like toothpicks and even destroy reinforced concrete structures or flatten small villages.

starting zone

The area from which an avalanche typically initiates.

flanks

The side boundaries of the slide.

bed surface

The surface upon which the snow slides, such as the ground or a snow layer (for example, sun crust).

telluride's san juan snowpack

Because our local snowpack basks in copious winter sunshine, lies at a fairly low latitude on steep mountains at high elevations, experiences drastic daily swings in temperature, and collects relatively little snowfall, it is infamous for being especially difficult to predict and prone to avalanche.

the cement factor

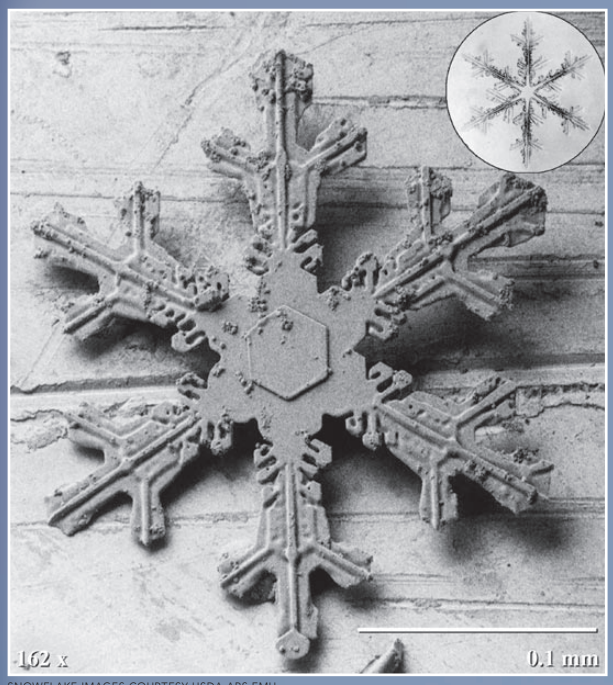
When snow moves at tremendous speeds, friction causes it to warm. After an avalanches comes to rest, the snow cools quickly and settles into a dense and compact debris. There's little air for buried victims to breathe, and rescuers have to be quick to respond, good with their rescue equipment and determined when digging. Successful rescues are usually completed in less than 15 minutes.

stauch wall

The bottommost boundary of a slide, which is usually buried by debris.

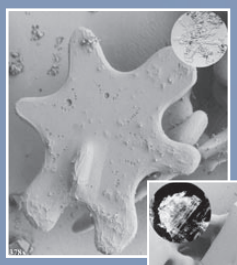
WHIT RICHARDSON

underneath it all



SNOWFLAKE IMAGES COURTESY USDA ARS EMU

THIS NEWLY FALLEN SNOWFLAKE, shown through a scanning electron microscope, is a classic stellar crystal. As soon as this flake hits the ground, it begins changing. Depending upon vapor and temperature differences, and other factors within the snowpack, it generally changes in one of two ways:



This flake has become rounded, a shape that tends to bond well with others like it, creating a cohesive layer in the snowpack known as a "slab."

This snowflake has become angular, and grains like this will continue to grow in size in the lower layers of a snowpack, called "depth hoar." Its angular edges don't bond well with neighboring grains, and this layer often becomes the primary weakness in a snowpack (particularly in the San Juan Mountains).

the san juan special

Neither rounded nor angular grains are a problem by themselves, but a cohesive mass of rounded grains (a slab) on top of a weak layer (such as depth hoar) is akin to a sheet of plywood on marbles.

while you were sleeping

Avalanche conditions may be safe one day and entirely different the next—even without overnight snowfall. Temperature fluctuations and wind, which scours snow from one place and loads it up in another, affect each day's conditions.

the beta

To check daily avalanche and mountain weather conditions throughout the state, visit www.avalanche.state.co.us. Online, the "Northern San Juan Zone" is specific to Telluride. Avalanche courses are offered regularly in Telluride and other mountain communities.

powder cloud

The leading edge of the moving snow as it slides.

track

The area in which an avalanche runs.

runout

The place where the avalanche debris comes to a stop.

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