Each mine has its own characteristics that affect roof control.

The width of the entry has an effect on roof stability.

The direction of the mine into the stone also affects roof stability.

It is best to establish the mine entry on a bedding plane.

Training hours are mandated by MSHA. On-the-job training is invaluable.
Geology and technology stabilize roof conditions

Stone doesn’t talk, so miners must learn to look for the external signals the mine emits. A foreman always conducts a pre-shift mine check using a detailed checklist, scanning the roof, floor, and pillars for such things as rocks on the roadway, intersecting cracks or joints in the roof, bolts on the floor, and color changes in the roof (water, drying, cracking, or evidence of fallen rock). Miners themselves must always be on the lookout during their shifts, watching for anomalies in the stone.

A major commandment in underground stone mining is that no miner should ever advance beyond a scaled area. Scaling in a mine is a continuous process. As they work, scales move from good, known scaled conditions to lesser-known, unscaled conditions. Scaled roof sections can be identified by the scale tracks, which are lighter-colored scratch marks in the stone. Even after a section has been scaled, the miner must follow up and provide maintenance scaling.

Mechanical scaling is an effective method for knocking larger loose stone off of the mine’s roof and walls, but it is ideal to follow up mechanical scaling with manual scaling to better ensure management of all loose stone. Additionally, manual scalers can help inspect the roof from a vantage point of height, looking and listening, as well as searching for cracks, bulges, and dropped edges. Manual scalers also can mark sections for roof bolting in mines that use mechanical bolts.

Every mine is geologically unique, but on an underground stone mining wish list for ideal geological conditions, having a roof lie in a bedding plane is at the top. In a bedding plane that runs parallel to the ground, the roof’s rock will break off in layers or slices, leaving a smooth surface. Joints, which run perpendicular to the ground, the roof’s rock will break off in layers or slices, leaving a smooth surface. Joints, which run perpendicular to the ground, are not desirable. In some underground stone mines where the rock layers in the roof are thinner, the roof must be shored up with mechanical bolts. Much like thin layers of wood are compressed and glued together to create strong plywood, roof bolting compresses and fastens layers of rock to create a strong, rigid, beam-like roof. New technology in roof mapping allows the miners to know locations of voids and solid rock, along with hardness, to ensure correct drilling control, bolt length, and resin amounts.

Conditions in a mine can change in a blink of an eye, and it is difficult to impart information in a classroom or through reading about the inherent hazards, yet how a miner reacts to a hazard can make all of the difference in controlling it. While MSHA mandates the hours underground miners must be trained, the best training is on the job, working with an experienced miner who can teach a new miner about the sights and sounds he or she must know.
ACCORDING TO BILL GRANVILLE, OWNER OF J.W. GRANVILLE CONSULTING AND ACTING VICE PRESIDENT OF OPERATIONS AT GARETT LIMESTONE, GARRETT, PA., GEOLOGY IS EXTREMELY IMPORTANT, AND KNOWING HOW TO READ CONDITIONS TAKES EXPERIENCE. “GEOLOGY IS SO IMPORTANT, IF I COULD ONLY HIRE ONE PERSON FOR AN UNDERGROUND STONE MINE, I WOULD HIRE A GEOLOGIST OVER A MINING ENGINEER,” HE SAYS.

In general, it is difficult to find experienced underground hard rock miners. The state of Pennsylvania requires that each underground mine have a licensed underground foreman for each shift. The foreman must conduct a pre-shift inspection prior to the start of all shifts in the mine. “The goal every day in an underground mine is to make sure every miner goes home safe,” Granville says. He explains that a large portion of controlling roof conditions includes scaling.

Mechanical scaling machines use a boom with a hooked end that scrapes the roof and walls to remove loose material. Prior to the development of the scaling machine, miners would use scaling bars and scale the surfaces by hand. “I still encourage hand scaling to go along with mechanical scaling,” Granville says. “The mechanical scaler brings down the large material. Hand scaling brings down the smaller material. And when the miner is up near the roof in a scaling basket, he can look for hazards and listen for sounds that are out of place. A hand scaler can also mark with paint where the roof bolts should go in a mine that requires bolting.”

Garrett Limestone had previously been an open-pit quarry. Five years ago, the company hired Granville to take the operation underground. “The mine is now in full operation. Going underground is not for the weak of heart,” he says. “Companies can spend millions to go underground and still be unsuccessful.”

New technology that electronically controls drilling and bolting has resulted in systems that make roof mapping more user friendly. According to Craig Collins, electrical engineering manager for J.H. Fletcher and Co. of Huntington, WVa., the primary purpose of the system is to efficiently drill and consistently bolt, but a secondary benefit is that the system graphically maps for the operator the locations of voids, bedding planes, and contrasting rock hardness in real time.

“A proactive approach to roof control is always best,” Collins says. “And faster access to information is a key.” Collins explains that each mine has unique characteristics that dictate the method of advance and the way the roof is to be bolted. “If the miner can recognize how the roof characteristics are changing in real time, then they can make the proper adjustments to the method of advance and to the roof control.”

When roof control adjustments are made during the initial production cycle, it provides a safer roof and will minimize the labor and material costs associated with “repair bolting,” he says. “The best roof control actually starts with proper drilling and blasting at the face, notes Collins. “It makes for a better roof. It cuts down on scaling, improves bolting. I’ve heard from many managers that if the operators drill the face right, the roof control straightens right up,” he says.

JOSEPH FLICK, DIRECTOR OF THE MINER TRAINING PROGRAM AT PENN STATE UNIVERSITY. “ONE OF THEM IS THAT UNDER NO CONDITION — NEVER, NEVER — MUST A MINER GO BEYOND A SCALING ROOF. SCALING IS A CONTINUOUS, NEVER-ENDING ROOF MAINTENANCE PROCESS. THE SCALER WILL SCALE ONE SECTION OF ROOF, THEN GO BACK AND FOLLOW UP WITH MAINTENANCE SCALING. IF THERE IS EVER ANY REAL OR SUSPECTED LOOSE ROCK, IT MUST BE TAKEN DOWN.”

AN UNDERGROUND MINE HAS SO MANY SIGHTS AND SOUNDS THAT A MINER MUST UNDERSTAND. AND WHILE CLASSROOM AND TASK TRAINING ARE EXTREMELY IMPORTANT, IT IS ON-THE-JOB TRAINING UNDER AN EXPERIENCED MINER THAT REALLY HELPS UNDERGROUND MINE WORKERS TO LEARN WHAT THEY SHOULD SEE AND LISTEN FOR.

“THE MINE IS NOW IN FULL OPERATION. GOING UNDERGROUND IS NOT FOR THE WEAK OF HEART,” HE SAYS. “COMPANIES CAN SPEND MILLIONS TO GO UNDERGROUND AND STILL BE UNSUCCESSFUL.”