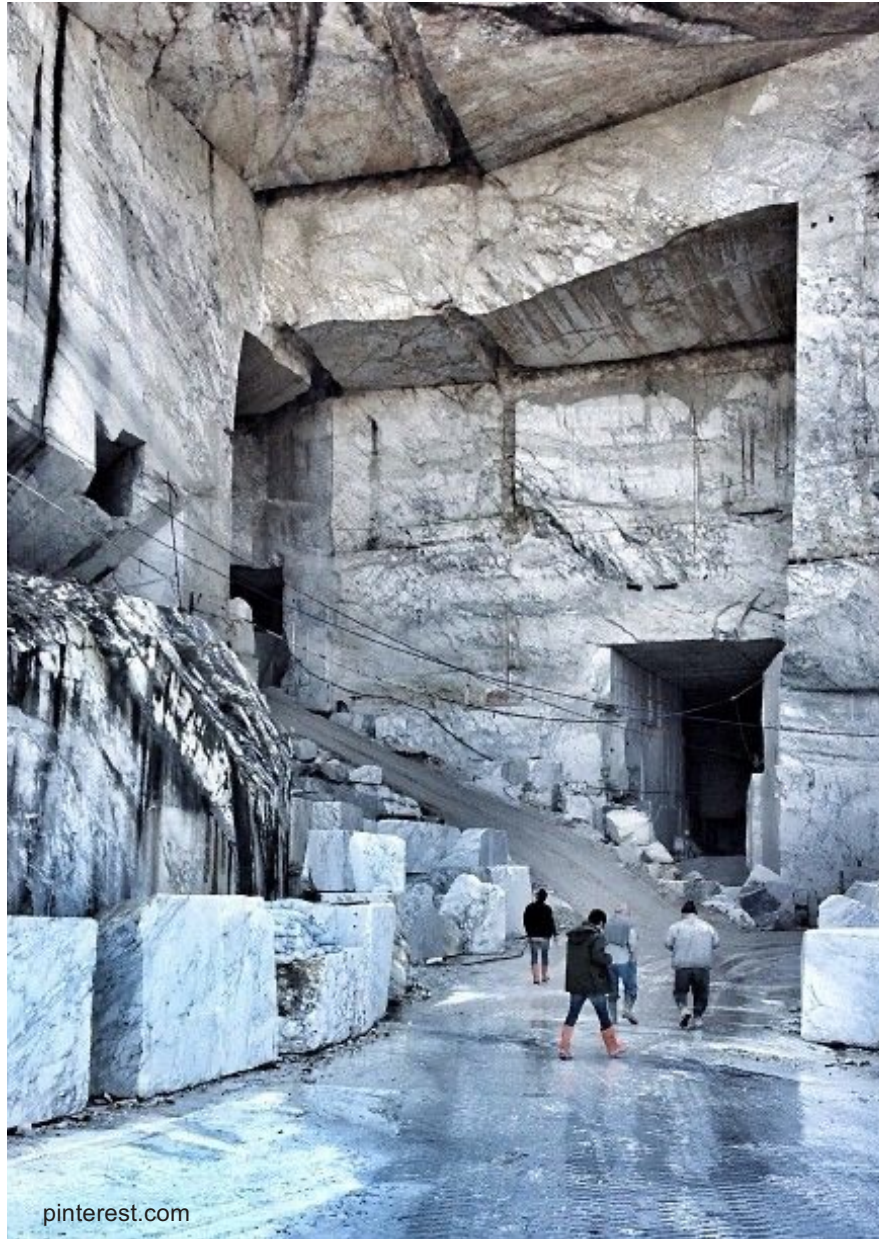


Heat stress in underground mining/tunneling



Federica Prioglio
Georgia Togni



OUTLINE

Hazard identification

Background information

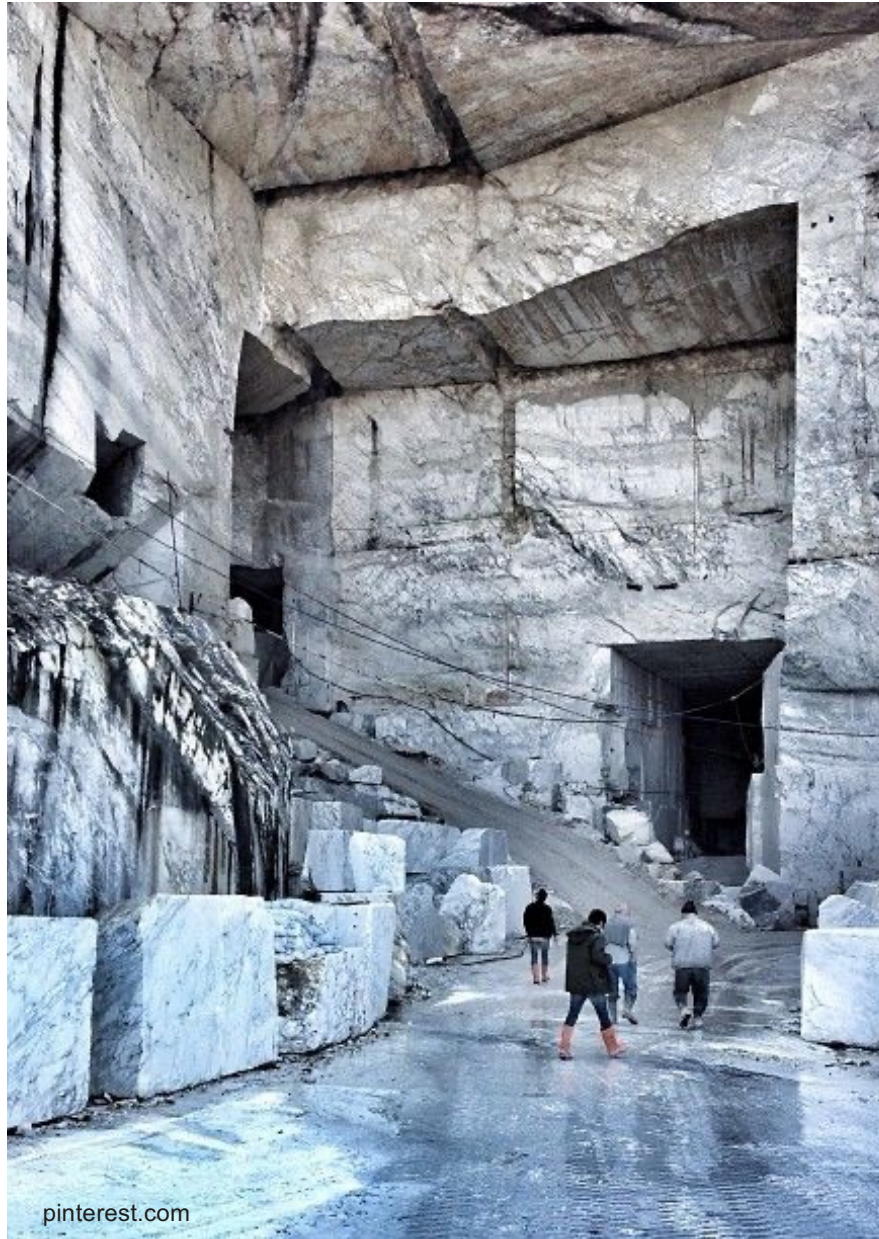
Risk assessment

Relevant regulations

Recommendations

What is heat stress?

- **Heat stress** is a condition resulting from the body's inability to cool itself effectively when exposed to high temperatures, often compounded by humidity, physical exertion, and limited airflow. It occurs when environmental factors or physical activity increase the body's internal temperature faster than it can be regulated through natural cooling processes, like sweating and blood flow adjustment.



Hazard identification

Background information

Risk assessment

Relevant regulations

Recommendations

Hazard identification

Primary Hazards:

- High temperatures
- Humidity
- Confined spaces
- Lack of ventilation



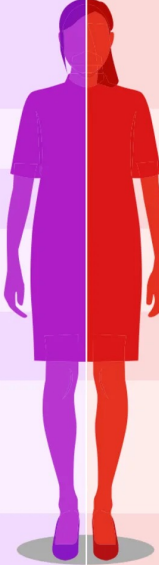
Hazard identification

Health risks:

- Dehydration
- Cardiovascular strain
- Heat cramps
- Heat exhaustion
- Heat stroke

Differences between heat exhaustion and heatstroke

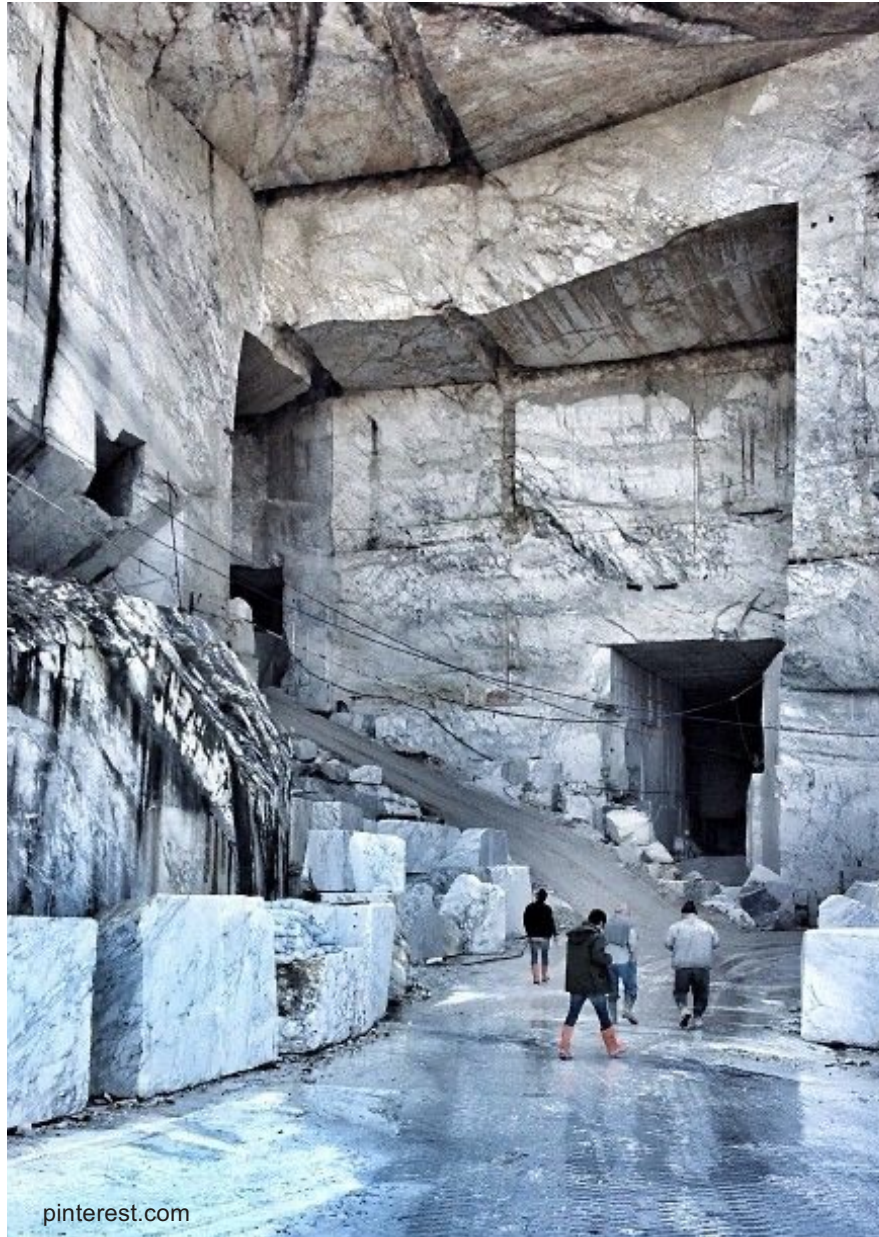
Heat exhaustion	Heatstroke
Feeling faint or dizzy	Feeling confused
Excessive sweating	No sweating
Clammy skin	Temperature over 40C, hot, dry skin
Nausea or vomiting	Nausea or vomiting
Muscle cramps	May lose consciousness or experience convulsions or seizures



Source: NHS

BBC

<https://www.bbc.com/news/health-62120167>



Hazard identification

Background information

Risk assessment

Relevant regulations

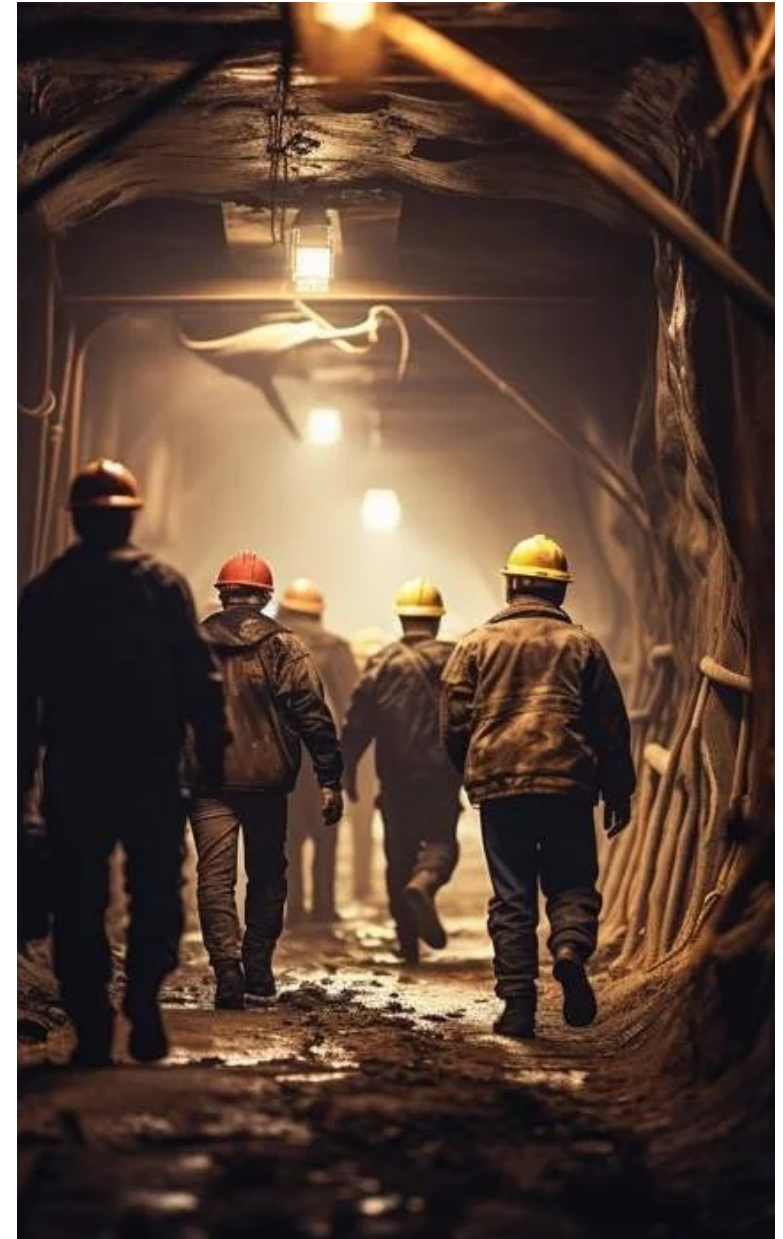
Recommendations

Background information

High temperatures:

- Geothermal gradient
- Mechanical equipment
- Ventilation limitations
- Human metabolic heat

Humidity



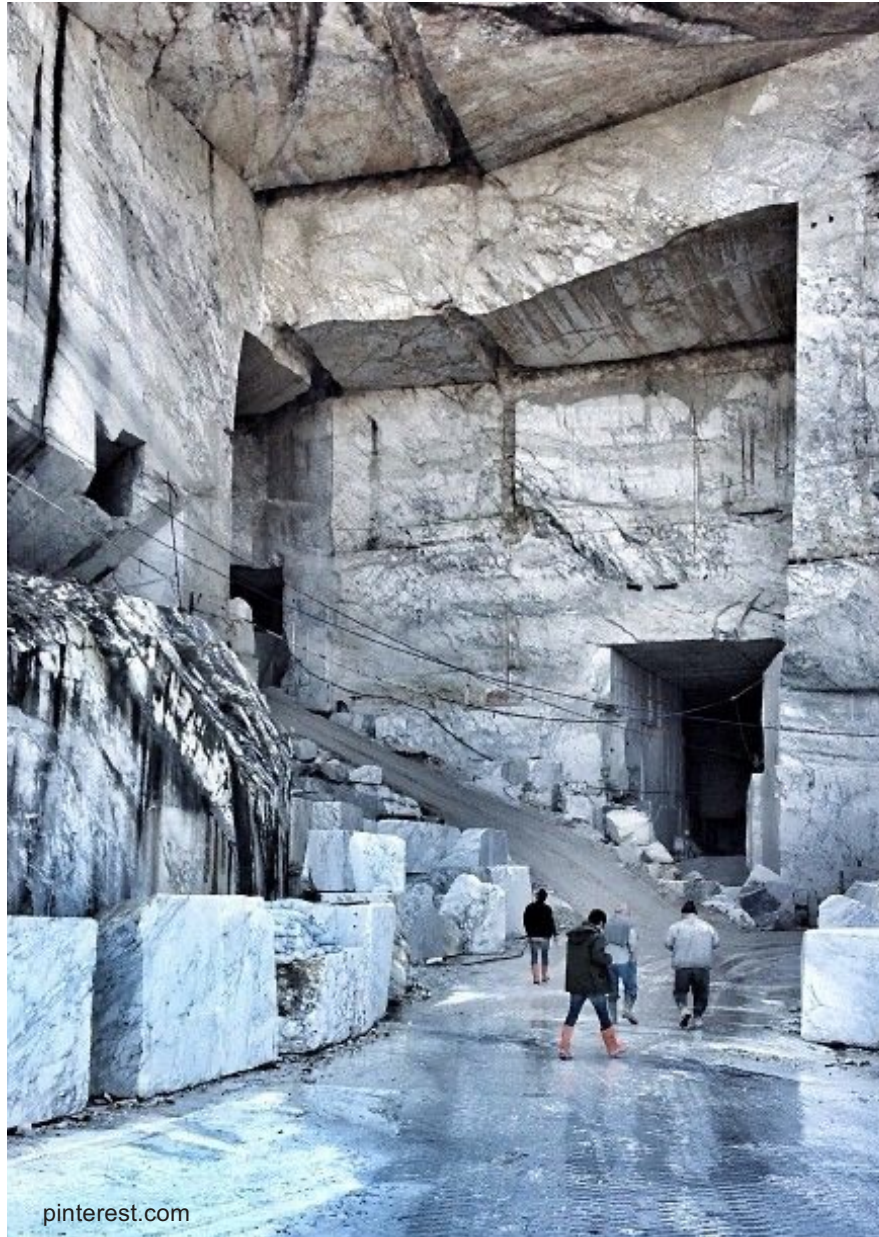
Background information

Aggravating factors:

- Humidity
- Excess heat
- Heavy clothing

Protective factors:

- Ventilation systems
- Hydration stations



Hazard identification

Background information

Risk assessment

Relevant regulations

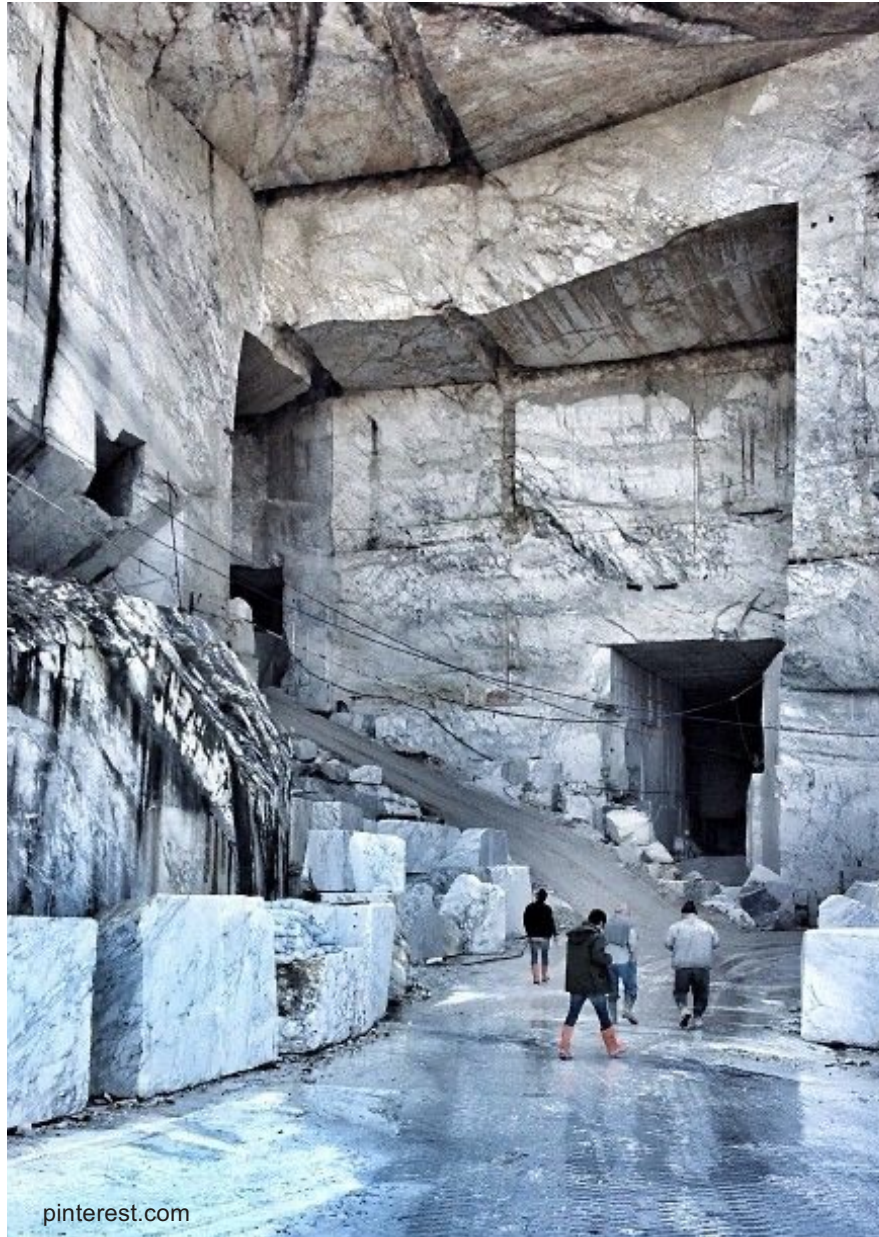
Recommendations

Risk assessment

Risk level: HIGH

Illness data:

- Increased accident rates correlated with temperatures exceeding 28-30°C in mining environments
- 15-30% of miners experience heat-related symptoms (headaches, dizziness, muscle cramps)
- The rate of heat exhaustion can be 3.17 times higher than in shallower mines (below 1200m)



Hazard identification

Background information

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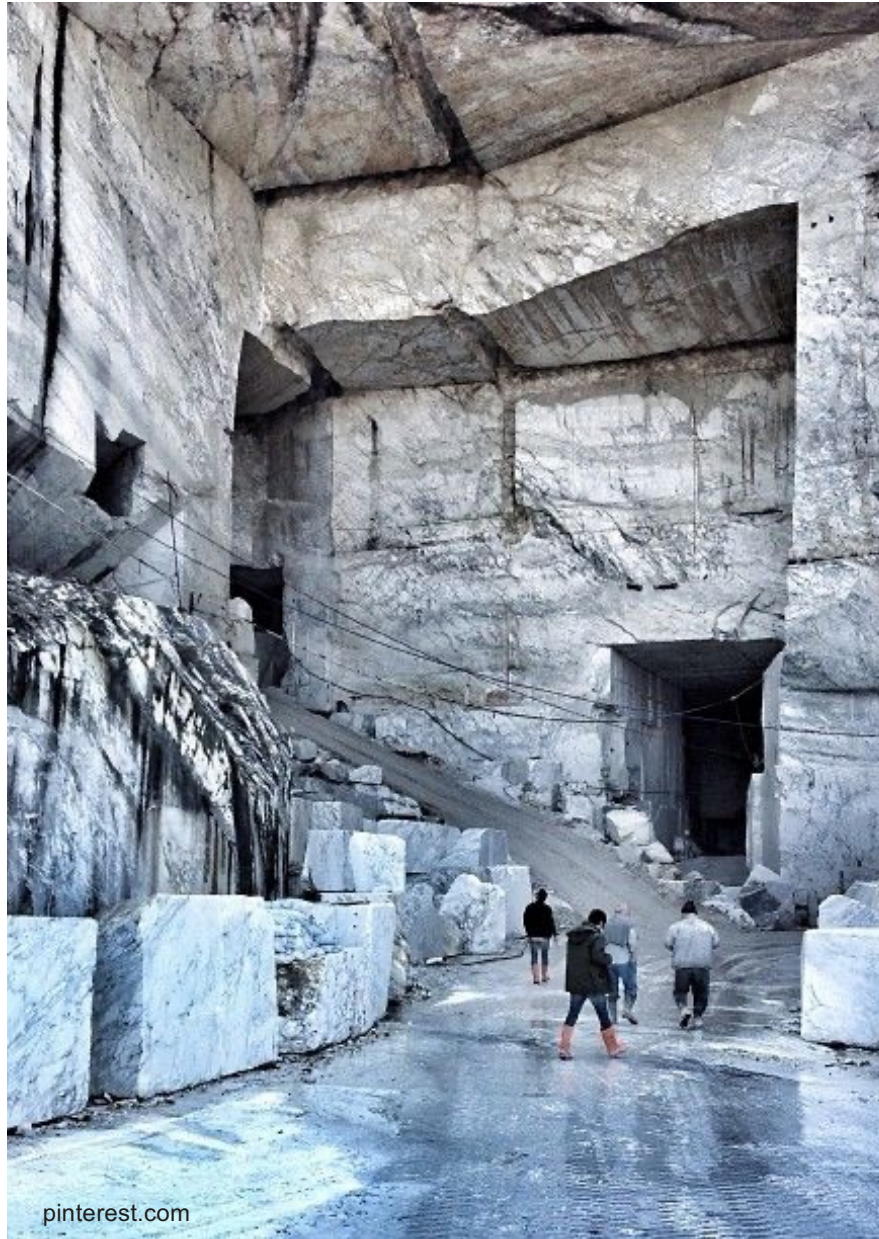
Relevant regulations

International Standards:

- **ISO 7243:** Guides on monitoring heat stress based on the Wet Bulb Globe Temperature (WBGT).
- **OSHA (Occupational Safety and Health Administration):** Although primarily US-based, OSHA sets guidelines for managing workplace heat stress.
- **MSHA (Mine Safety and Health Administration):** Although primarily US-based, MSHA enforces safety and health regulations in the mining industry

Good Practices in Mining:

- **ICMM Guidelines:** International Council on Mining and Metals recommends robust ventilation, acclimatization protocols, and mandatory hydration



Hazard identification

Background information

Risk assessment

Relevant regulations

Recommendations

Recommendations

Engineering controls

- Ventilation systems
- Refrigeration and cooling system
- Chilled water pipelines

Personal Protective Equipment (PPE)

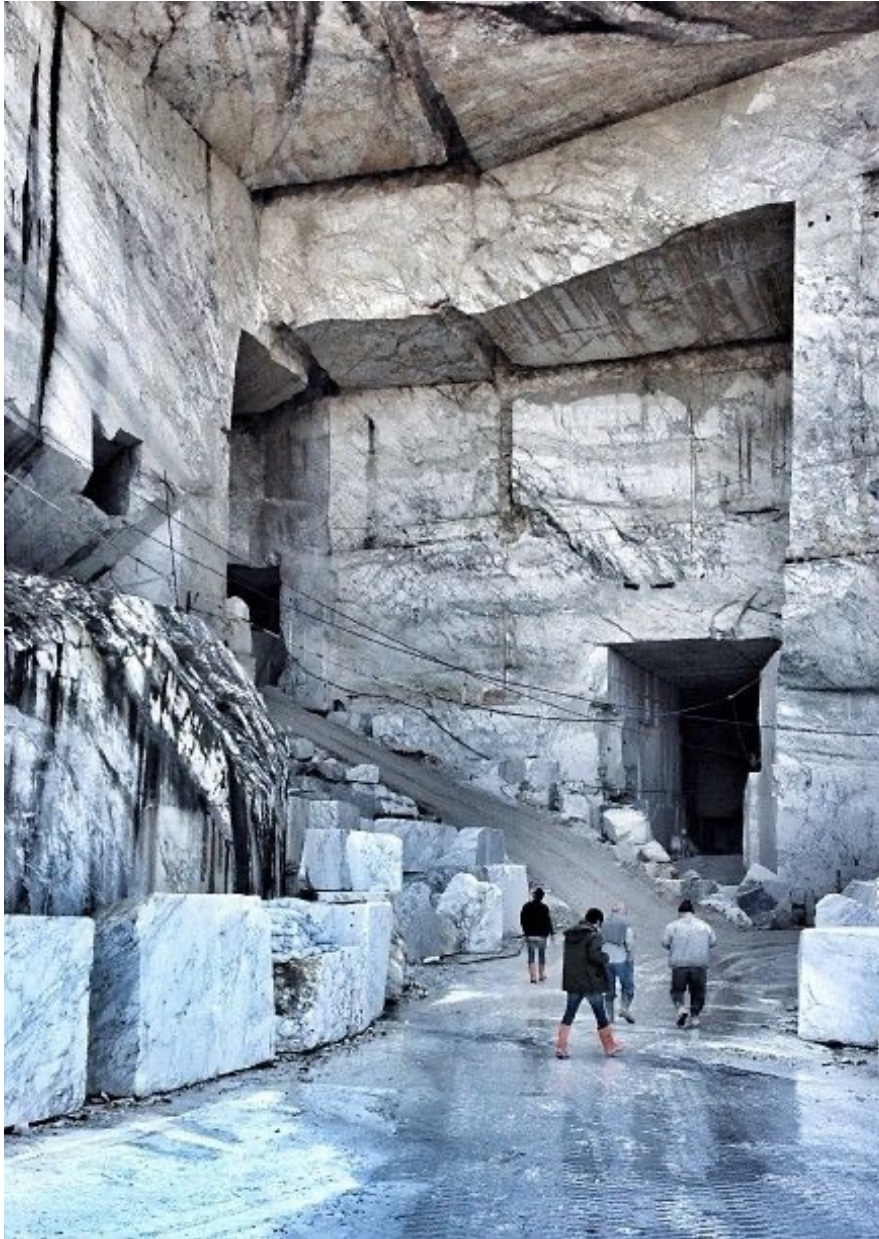
- Cooling vests
- Breathable clothing
- Hydration packs

Administrative controls

- Work-rest cycles
- Shift scheduling
- Acclimatization programs

Monitoring and emergency response

- Wearable sensors
- First aid training
- Buddy system
- Self-pacing



Conclusion

- Heat stress poses serious risks in mining and tunneling.
- Effective prevention strategies include engineering controls, administrative policies, and personal protective equipment.
- Adherence to international standards can greatly reduce the risks.

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Thank you for your attention!

Questions?

