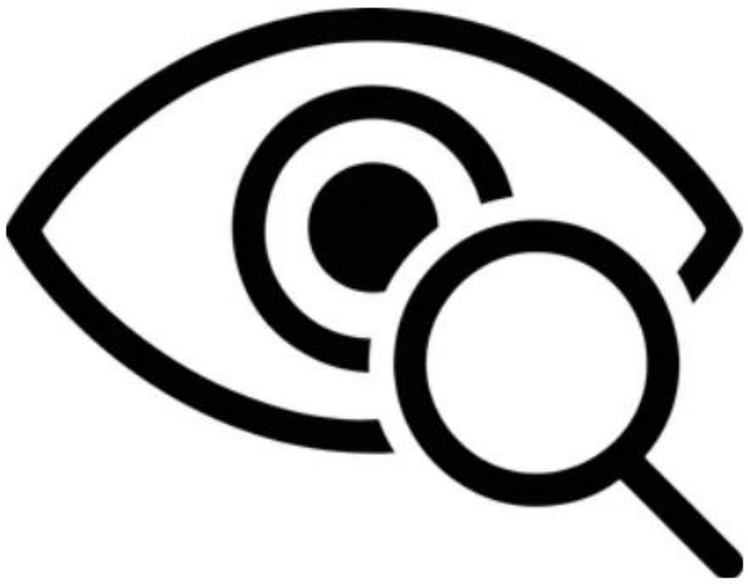
ROOM GUIDE · LARGE PRINT

Room 1

Geology

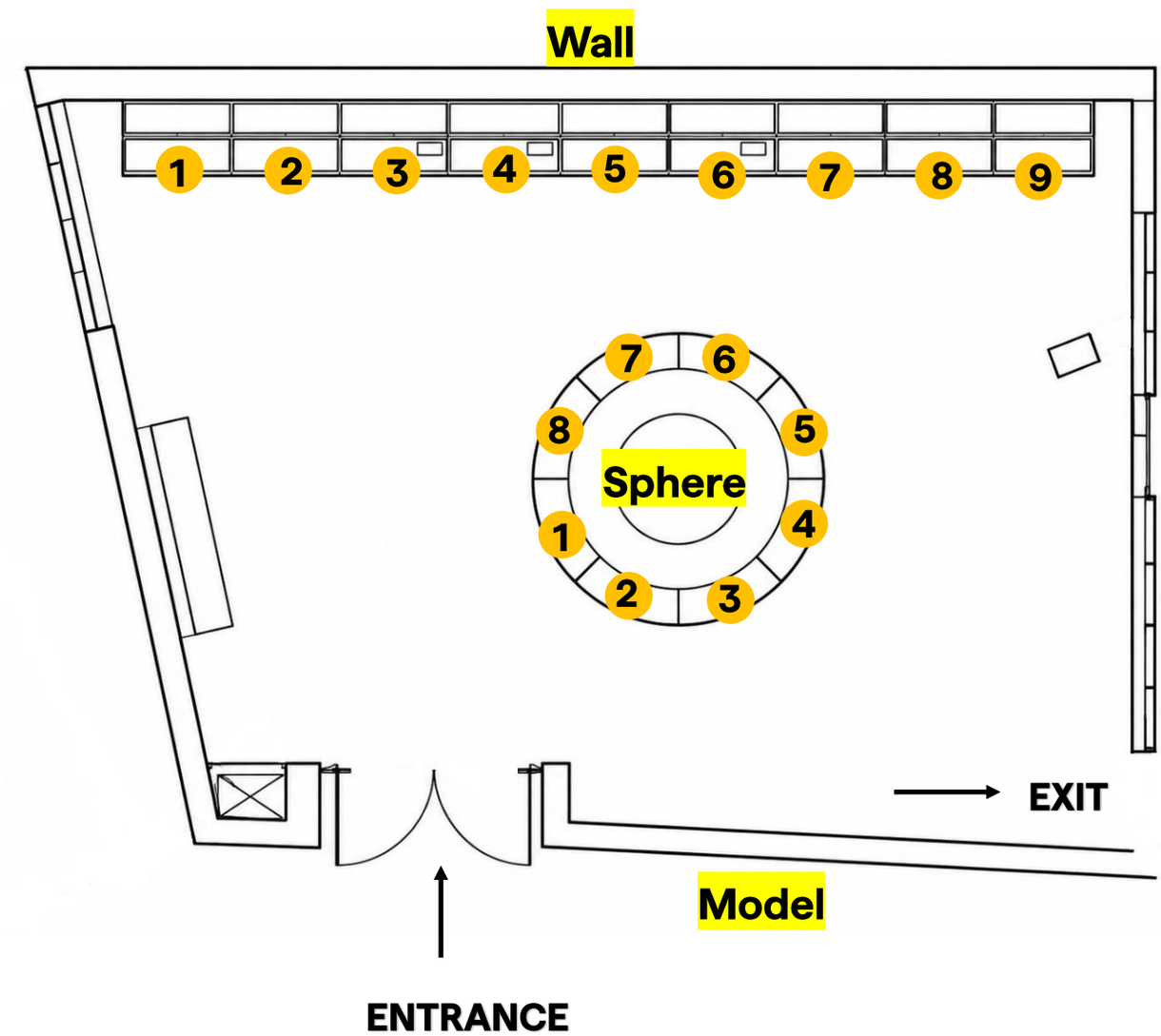


Rock foundations

For a planet in motion

Since its formation, Earth has been in constant change. Deep within, energy inherited from the universe drives physical and chemical processes that move tectonic plates. At the surface, this appears as volcanism and earthquakes, which, together with erosion and climate, shape the landscapes of Atacama.

Room 1 plan



A Mineral Landscape

Evidence of a planet in motion

Throughout its 4.6-billion-year history, Earth and its internal energy have transformed our world. From the core to the crust, geological processes shape the land and create the mineral wealth that characterises Atacama today.

Sphere

1. Meet the Earth

From cosmic particles to a rocky planet

Around 4.6 billion years ago, our planet began as a vast cloud of dust and gas in space. Through a process called accretion, gravity pulled these particles together into increasingly larger bodies. Over time, they formed a planet of molten rock, similar in size to Earth today.

Towards a planet of continents

About 100 million years after its formation, Earth began to cool and separate into internal layers. Denser materials sank to form the core, while lighter materials rose to form the mantle and crust. Over time, the surface stabilised and the first protocontinents, known as cratons, emerged.

2. The phases of Earth

Continents through time

EONS	ERAS	PERIODS
Hadean		
Archean		
Proterozoic		
Phanerozoic	Paleozoic	Cambrian
		Ordovician
		Silurian
		Devonian
		Carboniferous
		Permian
	Mesozoic	Triassic
		Jurassic
		Cretaceous
	Cenozoic	Paleogene
		Neogene
		Quaternary

3. Bits and pieces

Inside the Earth

During the first few hundred million years, our planet separated into its main internal layers: the crust, mantle, outer core and inner core.

Mineral composition

Based on its chemical composition, Earth can be divided into four layers: the crust, mantle, outer core and inner core.

Rheological structure

Based on how rocks behave under geological forces, five layers can be distinguished: the lithosphere, asthenosphere, mesosphere, outer core and inner core.

4. Journey to the centre of the Earth

An imaginary adventure

Temperature and pressure increase with depth, limiting direct study of the planet's interior. Of the roughly 6,370 kilometres between us and the core, we have drilled through only 0.2% of the Earth's crust —about the distance from Copiapó to Paipote.

5. Many fragments, one world

The crust is the planet's outer layer. It supports life and contains the mineral resources we use every day. Together with the upper mantle, it forms the lithosphere, which is divided into 14 major tectonic plates. These enormous blocks move slowly towards, away from or past one another.

Tectonic plates

A shifting surface

Around 3 billion years ago, Earth's magma ocean began to solidify, forming a thin rocky crust. Internal activity, meteorite impacts and contraction as the planet cooled gave rise to the first tectonic plates and to the cycle of crust formation and destruction that continues today.

6. Deciphering the puzzle

A planet of tectonic plates

Until the early 20th century, continents and oceans were thought to have always remained in the same place, with no clear explanation for phenomena such as earthquakes or volcanoes. In 1912, Alfred Wegener proposed the Theory of Continental Drift, changing the way Earth was understood.

Evidence for a revolutionary idea

Wegener brought together several lines of evidence supporting his theory that the continents had once formed a supercontinent called Pangaea before separating:

1. The shapes of the continents suggested that they fit together like pieces of a puzzle.
2. Fossils of the same plant and animal species found in Africa, South America, India and Australia suggested these lands had once been connected.
3. Similar rock formations, formed at similar times and in similar environments, were found in places that are now far apart.

How can continental movement be explained?

Years later, in 1931, British geologist Arthur Holmes proposed that convection currents in the mantle could drive tectonic plate movement. These circular flows, caused by differences in temperature, would power the movement of the plates.

7. The Earth’s mantle

Highways of fire

Beneath the crust lies the mantle, a layer of ductile rock that makes up around 84% of the planet’s volume. Its physical behaviour changes with pressure and temperature. In its uppermost layer, the asthenosphere, convection currents carry heat from the core towards the surface, allowing tectonic plates to move.

8. The core

Inner power

At the centre of the planet lies the core, composed mainly of iron and nickel. Denser than other materials, these metals sank and became concentrated deep inside Earth. The core has two parts: a liquid outer core and a solid inner core, each playing a different role in the planet’s geological system.

From the centre... and beyond!

A vital shield

Like a magnet, Earth’s outer core generates a magnetic field that acts as a protective shield against solar wind and cosmic radiation.

Wall

1. Atacama

A land of fire

Chile lies within the Pacific Ring of Fire, one of the most seismically active regions on Earth. Here, several oceanic plates sink beneath others in a process called subduction. Most of the world's volcanoes are concentrated along these boundaries, giving the Ring of Fire its name.

- In Chile, the movement of tectonic plates has shaped the landscape over millions of years. The Coastal Range and the Andes are examples of landforms formed through this process.
- The Atacama Trench is where the Nazca Plate sinks beneath the South American Plate.

2. No let-up

Seismic Chile

As long as Earth continues releasing energy from within and tectonic plates keep moving over the mantle, earthquakes will continue to occur. Chile records an average of one

hundred tremors a day, although many are imperceptible and can only be detected by seismographs.

A seismic nation

Local memory

Historical records from Atacama document several megathrust earthquakes. In the 20th century, the most destructive struck in 1918 and 1922. The latter left Chañaral, Copiapó and Vallenar almost completely destroyed. Together, these earthquakes claimed around 800 lives.

Atacama in ruins

The 1918 earthquake

Contemporary reports indicate that nearly half of the 1,630 houses were destroyed or seriously damaged.

3. Offshore earthquakes

Destruction along the coast

Atacama has a long history of tsunamis, with geological evidence of several events along its coast. The 1819 and 1922 tsunamis stand out for the devastation they caused in northern Chile and for effects that reached as far as Japan.

- **What is a tsunami?**

  A tsunami is a series of giant waves caused by a major earthquake near the coast or beneath the sea, or by landslides and underwater volcanic eruptions. The word comes from Japanese: *tsu* means harbour and *nami* means wave, together meaning “harbour wave”.

4. Explosive release

Transforming the landscape

Volcanoes connect Earth’s interior with the surface. During eruptions, they release ash, gases, water vapour and lava. Depending on their intensity, eruptions can reshape the land, alter ecosystems and affect human activities.

- Atacama is home to the world’s highest active volcano, Ojos del Salado, which rises to 6,893 metres.

Volcanism, two “worlds” in one

At least six volcanoes in northern Atacama are considered active, while no volcanic activity is recorded farther south. This difference has a geological cause: two types of subduction meet here, inclined and flat-slab.

The “active” side of Atacama

Most of Atacama’s volcanoes are concentrated north of Copiapó, where the subduction angle is steeper, averaging around 25°.

5. Rocks of Atacama

Mineral garden

This wall shows only a fraction of the many rocks found in Atacama. Their textures, colours and shapes reveal clues about their origin, mineral composition and crystal structure.

How do rocks form?

Rocks form through different geological processes, including heat, pressure and sediment compaction. Some form inside the Earth, including in volcanic environments, while others form in rivers, mountains and oceans.

- **What are rocks?**

  They are natural mixtures of minerals, which are themselves made of chemical elements.

What are minerals?

For a substance to be considered a mineral, it must:

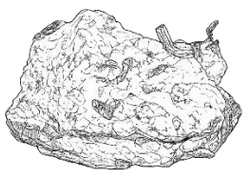
1. Be inorganic, meaning it does not come from living organisms.

2. Have a crystal structure, with atoms arranged in an ordered pattern.

3. Be solid.

4. Form naturally on Earth.

Featured collections



Native silver (Ag)

Mina Dolores, Chañarcillo

323.1

Luanheite — Ag_3 Hg

Elisa de Bordos

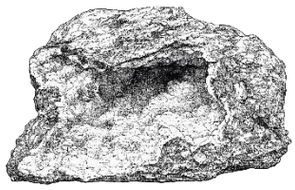
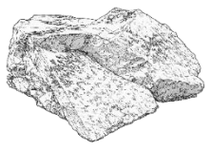
323.7

Native copper (Cu)

Mantos Negros

323.21

These specimens show minerals in their native, or “pure”, state. Copper forms flakes, while silver forms filaments resembling twisted threads.

	**Drusy chrysocolla** **$Cu_2\ Al(H_2\ Si_2\ O_5\ )(OH)_4\ \cdot nH_2\ O, x < 1$** Manto Tres Gracias 323.2
	Desert rose $CaSO_4\ \cdot 2H_2\ O$ Caldera 232.23
	Garnet $X_3\ Y_2\ (SiO_4\ )_3$ Chimbero 323.75
	**Dendritic pyrolusite MnO_2** Puquios 323.19
	Orbicular granite Pl-Hbl-Bt-Qtz ± Px ± Mag ± Kfd Orbicular Granite Nature Sanctuary, Caldera. On loan from the Mineralogical Museum RXI-130 The word orbicular comes from the Latin orbicularis, meaning round or ring-shaped. The darker circles in this granite formed when a sudden change in the magma caused minerals to crystallise around a central point.
	Proustite $Ag_3\ AsS_3$ Replica RM.1.103

6. Metallic mineral deposits

A product of subduction

When an oceanic plate sinks beneath another, heat and pressure in the mantle generate magma, which rises towards the surface carrying metals such as gold, silver, copper, iron and zinc. As it approaches the surface, it cools and crystallises, creating the conditions for a mineral deposit to form.

- Unlike metallic deposits, which form from magma at great depths, non-metallic minerals —such as salt, gypsum and clays— form closer to the surface.

7. From the Earth's crust to our lives

Mining extracts and refines metallic and non-metallic minerals from the Earth's crust. These are essential to many industries, including technology, construction and energy production.

Mining map of Atacama

Copper mines

Gold mines

Iron mines ○

Limestone mines ●

- Look at the distribution of metals on the map: their location is not random. Iron mines predominate along the coast, copper mines in the central area and gold mines towards the Andes.

More than copper...

Chile also extracts other metallic minerals, including molybdenum, silver, mercury and manganese, as well as non-metallic minerals such as lithium salts, quartz and iodine.

8. Beyond extration

The contribution of recycling

Although extractive mining is essential for clean technologies, it also has environmental and social impacts. Urban mining recovers metals from electronic waste —such as mobile phones and computers— as a more sustainable complement to traditional mining. It reduces e-waste, creates jobs and lowers environmental harm.

Recycling mode, an urgent change

Electronic waste, such as mobile phones and household appliances, releases toxic substances that harm the environment and human health. According to the UN Global E-waste Monitor 2024, less than 20% of this waste is recycled, while e-waste is growing five times faster than it is being recovered.

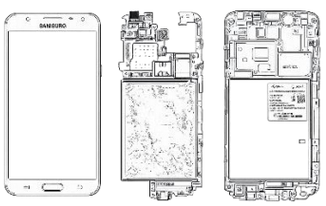
High grade

While a gold mine may yield around 6 grams of metal per tonne of raw material, electronic waste can yield around 350 grams per tonne.

- Minerals recoverable from electronic waste include gold, silver, copper, iron, tin and aluminium.

Featured collections

	Copper cables 26.21 **Concentrate of copper, silver, gold and rare-earth metals** 26.22 Donated by Midas Chile

	Copper ingot Donated by Midas Chile 26.24 This ingot was made from copper recycled from 100 kilograms of circuit boards from computers and mobile phones.
	① **Aluminium ingot** 26.25 ② **Bronze ingot** 26.26 Donated by Midas Chile
	**Mobile phone** ① Screen (cerium, aluminium, indium, oxygen, silicon and potassium) 26.27.A ② Circuit board and battery (lithium, cobalt, carbon, aluminium, nickel, cadmium and manganese) 26.27.B ③ Casing (hydrogen, magnesium, bromine, titanium, chromium, fluorine, nickel and chlorine)

	26.27.C Donated by Midas Chile

9. Hands on the rocks

Geology is the science that studies our planet: its origin, composition and internal structure, as well as the processes that shape its surface. It ranges from analysing rocks, minerals and fossils to understanding natural phenomena such as volcanoes, earthquakes and debris flows.

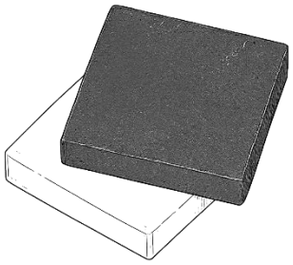
Geological history

Geology studies the composition and age of rocks. This map shows the geological eras found in Atacama and how they are distributed across the territory.

A planet to discover

Geological work can include expeditions to volcanoes and areas affected by earthquakes or debris flows, as well as research along the coast and on the seabed. It also includes laboratory work, where rocks, minerals and fossils are analysed and the planet’s inaccessible internal conditions are recreated.

Featured collections

	Scratch tester 26.31 Helps determine mineral hardness.
	**Ceramic streak plates** 26.32 Used to identify minerals by the colour of the powder they leave when rubbed across the plate.
	Hydrochloric acid HCl 26.33 Helps identify the presence of carbonates.
	Rock sample set for the Mohs scale 26.36 (A-L) A guide for classifying minerals by their hardness.

Model

Beneath our feet

Atacama's geological evolution has been closely linked to subduction for more than 300 million years, although the process has varied over time. North–south bands of rock record different stages: ancient magmatic activity along the coast and foothills, marine basins in the central area, and younger rocks linked to present-day volcanism in the high Andes.

Lithological map

Distribution of rock types in Atacama

Extrusive igneous

Intrusive igneous

Sedimentary

Metamorphic

The rock cycle

Nothing is lost, everything is transformed

The Earth's crust is composed mainly of three types of rock: igneous, metamorphic and sedimentary. They form under different conditions of temperature, pressure and geological

activity, both at the surface and within the planet. Over millions of years, rocks can move through different stages of the cycle, shaping the landscape and recording the constant transformation of the Earth’s surface.

Examples of rock types found in Atacama:

- **Sedimentary**
- **Volcanic igneous**
- **Intrusive igneous**
- **Metamorphic**

A story

Written in rock

By studying rock formations, minerals and the elements that make up the Earth’s crust, geologists have reconstructed many of the events that have shaped the planet since its formation around 4.6 billion years ago.

New inhabitants

Constant transformation

Around 3.8 billion years ago, the first organisms appeared on a previously lifeless Earth. Since then, living things have emerged, evolved and disappeared, giving rise to new species in a continuous cycle.

Earth’s memory

Strata are layers of rock formed over time by accumulated sediments such as sand and mud. Generally, deeper layers formed earlier. In the model in front of you, the metamorphic rock is the oldest unit, followed by strata 1, 2, 3 and 4. Studying these layers helps reconstruct geological history and past environments.

Stratigraphic section

- Stratum 4: This conglomerate is the most recent layer. It includes a replica fossil of a megalodon tooth *(Carcharodon megalodon)*.
- Stratum 3: Made of siltstone, it indicates calm-water environments such as the open sea.

- Stratum 2: Beach and dune environments accumulate sand, which can form sandstone.
- Stratum 1: Formed by conglomerates.
- Basement: The oldest rock unit, composed of metamorphic rocks. The model includes a replica of a Perisphinctidae ammonite fossil.

Script, curatorship and coordination

Exhibitions Department

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Museo Regional de Atacama

Atacama Region,

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DE
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