GOLD NUGGETS – SCIENCE & TECHNOLOGY

News: *Earthquakes could explain why gold nuggets are so frequently discovered in quartz veins, says new research.*

What's in the news?

Findings of the Study

- Orogenic quartz veins, those forming during mountain-building processes (Himalayas), have been the source of most gold nuggets.
- **Gold does not have much solubility in fluids.**
- Previous theory relied on the solubilization of large amounts of gold in water and subsequent precipitation in quartz veins.
- This is an incomplete theory since huge volumes of water would be required for significant gold deposits to accumulate.
- **Quartz is piezoelectric:** it produces an electric charge after mechanical deformation.
- Seismic waves associated with earthquakes cause quartz crystals to be strained, creating electric fields.
- These fields would induce electrochemical reactions capable of extracting gold dissolved in fluids surrounding the quartz and precipitating them onto the surfaces of the quartz.
- **Gold is a very good conductor of electricity.**
- When little gold is deposited, it promotes the electrochemical reaction. This allows more gold to accumulate in the same spot.
- This again could also be a reason behind the highly localized nature of nuggets.
- Repeated fracture strain and reactivation causes further advance in continuous accumulation of gold takes place within the quartz veins.

QUARTZ

- Quartz is a **silicate mineral**composed of silicon dioxide (SiO_2).
- It is the second most abundant mineral in the Earth's continental crust (behind feldspar).
- **Crystal System: Luster**

Types of Quartz

Macrocrystalline Quartz includes varieties like:

- **Clear Quartz**(Rock Crystal).
- **Amethyst:**Purple-colored due to iron impurities.
- **Citrine:**Yellow or orange, formed by heating amethyst or by natural processes.
- **Rose Quartz:**Pink, due to trace amounts of titanium, iron, or manganese.
- **Smoky Quartz:**Brown to black, caused by natural radiation.

Cryptocrystalline Quartz includes:

- **Chalcedony:**A fibrous variety.
- **Agate:**A banded form of chalcedony.
- **Jasper:** Red due to iron inclusions.
- **Onyx:**Known for its black and white banding.

Formation of Quartz

- **Igneous Rocks:**Quartz crystallizes from molten magma.
- **Metamorphic Rocks:**Under high pressure and temperature, quartz is a key component in metamorphic rocks like quartzite.

Quartz veins and outcrops like this are actually fairly common in gold country. Some of them contain good gold worth crushing and processing.

- **Sedimentary Rocks:**Quartz grains are highly resistant to weathering and often accumulate in sandstones and riverbeds.

Occurrence and Distribution

Quartz is globally distributed and found in:

- **Geodes:**Hollow rock formations with quartz crystals growing inside.
- **Veins:**Quartz often forms veins in cracks of host rocks, depositing minerals.
- **Pegmatites:**Coarse-grained igneous rocks where quartz can grow as large crystals.

Major sources of quartz include: **Brazil, USA, Madagascar**.

Uses of Quartz

- Quartz sand is a **primary ingredient in glass production**.

- Quartz crystals are **used in watches, clocks, and other electronic devices** due to their ability to generate precise frequencies.
- Quartz is used in **optical instruments** due to its transparency and clarity.
- Ground quartz is **used in concrete, ceramics**, and as an aggregate in road building.
- Its hardness makes **quartz useful in sandpaper and cutting tools**.
- Quartz varieties like amethyst, citrine, and rose quartz are used in **jewelry making.**
- High-purity quartz is **used in the production of silicon wafers**, the foundation of semiconductor devices.
- Quartz is critical in the **production of photovoltaic cells** for solar panels.

Considerations

While quartz is generally safe, fine particles of quartz, known as **silica dust**, can pose health risk.

Key Stats

- In 2022, India exported $111M in Quartz, making it the 2nd largest exporter of Quartz in the world.
- India has over 4 billion tons of quartz and related minerals in reserves mainly mined from Haryana, Rajasthan, Andhra Pradesh, and Tamil Nadu.

GOLD

- Gold is a **chemical element**with the symbol **Au** (from the Latin "Aurum") and atomic number **79**.
- It is a soft, malleable, and ductile metal, known for its lustrous yellow appearance and resistance to corrosion.
- Excellent thermal and electrical conductor.

Forms of Gold

- **24 Karat (24K):**The purest form of gold, consisting of 99.9% gold. Pure gold is too soft for many applications.
- **18 Karat (18K):**75% gold, mixed with 25% other metals.
- **14 Karat (14K):**3% gold, more durable and commonly used in jewelry.
- **White Gold:**Alloyed with metals like nickel or palladium to give it a silvery appearance.
- **Rose Gold:**Alloyed with copper, giving it a reddish-pink hue.
- Gold naturally occurs in **nuggets**and **flakes**, often found in rivers, streams, and rock deposits.

Geological Formation

- **Lode Gold Deposits (Veins):** Found in veins within rocks, where hot fluids carry gold and deposit it in cracks and fissures.

- **Placer Gold Deposits:** Gold eroded from lode deposits and carried by water into riverbeds and streams, where it accumulates in sediment.

Major Gold-Producing Countries

- **China:**World's largest producer of gold.
- Australia.
- Russia.
- South Africa.
- United States.

Gold Reserves in India

- As of March 2023, India had gold reserves of 794.62 tons.
- The largest reserves of gold ores are located in Bihar (44 per cent), followed by Rajasthan (25 per cent), Karnataka (21 per cent), West Bengal (3 per cent), Andhra Pradesh (3 per cent), Jharkhand (2 per cent).

Gold in Science and Technology

- **Gold Nanoparticles:**Used in cancer research, drug delivery, and diagnostic tools.
- **Spacecraft Shielding:**Gold-coated materials protect spacecraft from radiation and heat.

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