Calcium and magnesium – the stony elements

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After sodium (Na) and potassium (K), calcium (Ca) and magnesium (Mg) are the most common (metallic) elements in our bodily metabolism.

Outside, we encounter calcium and magnesium in the northern limestone Alps, the Zugspitze for example, and in the Dolomites. The mountains are the evidence, turned to stone, that calcium and magnesium were already part of life in the primordial oceans millions of years ago.

Greetings from the primeval times

In times of climate change, solutions are constantly being sought to bind the carbon dioxide from combustion processes and store it harmlessly. Nature shows us how in the form of the carbonic acid salts (carbonates) of the light metals calcium and magnesium. They were once used for the skeletons and outer shields of corals, mussels and many other primordial organisms and come from the deposits of dried-up primordial oceans.

Tre Cime (Dolomites) above Lake Misurina

Calcium carbonate aka $CaCO_3$ occurs as limestone, marble or chalk. It is also formed from burnt lime (calcium oxide) when it is processed into mortar and sets in new buildings by absorbing carbon dioxide from the air. Calcium carbonate is popular filler for the production of paper and cardboard. As a food additive E 170, it is used as a white powder for colouring and neutralising acids in food. For the same reason, it is used in the production of antacids that bind gastric acid. Rügen (healing) chalk and abrasives in toothpastes also consist of calcium carbonate.

Magnesium carbonate ($MgCO_3$, E 504), is used analogously to adjust the pH of foods, in antacids and as a tablet excipient and release agent. As magnesia, it improves manual grip and binds sweat in equipment and climbing sports. The mixed compound $CaMg(CO_3)_2$ is the basic material of the "pale mountains" (Dolomites).

Reactive elements

Elementary occurrences of calcium and magnesium do not exist in nature due to the reactivity of the silvery-white light metals to water and oxygen. In the early days of photography, magnesium was used as flash powder when mixed with oxygen-releasing compounds. Today, due to its low weight, it is used in compact, stable form to manufacture the crankcases of engines.

Fatty acid salts

Calcium and magnesium practically only occur in salt-like compounds. Besides carbonates, they also include fatty acid salts ("lime soaps"), which used to be a side effect of using alkali soaps (e.g. bar soaps such as curd soap) in combination with hard water. This is because they settled as an unsightly deposit on the edge of the pool.
The hardness components of water consist either of the water-soluble hydrogen carbonates (temporary hardness) or sulphates (permanent hardness) of calcium and magnesium. The term "temporary" results from the behaviour of the hydrogen carbonates. They precipitate as insoluble carbonates when water is heated, releasing carbon dioxide, and form the scale. Calcium sulphate (gypsum), on the other hand, remains in solution.

The long-chain acids of the skin barrier similarly form fatty acid salts with hard water – especially if the barrier is disturbed. In dry and atopic skin, it therefore makes sense to remove the hardness formers from the water in order to prevent further damage to the skin barrier. Alternatively, softening can be achieved as described by using small amounts of curd soap.
On the other hand, fatty acid salts of magnesium in particular stabilise W/O emulsions of skin care creams. They also act as excipients in make-up products.

Magnesium silicates

In this context, the soft soapstone should be mentioned, which indeed feels like fat bacon and is sold in powder form as talc. Talc, in contrast to the fatty acid salts, is a purely inorganic material – a magnesium silicate with the formula $Mg_3[Si_4O_{10}](OH)_2$. The relationship with similarly composed asbestos minerals, which can sometimes occur as accompanying substances in talc, has led to powders often being advertised as talc-free. In general, the handling of respirable, non-biodegradable silicate dusts, especially their fibrous modifications, is seen as a risk.

Hard bones

How stable and long-lasting calcium compounds can also be is shown by our hydroxyapatite bones and tooth enamel. They are formed from a specially composed calcium phosphate. The chemical formula is $Ca_5(PO_4)_3OH$. Calcium phosphates, like carbonates, are found in toothpastes. Literally "hard lumps" are kidney stones, which can contain calcium and magnesium phosphates, among other things.
Speaking of gypsum (calcium sulphate): The naturally occurring material, which is produced during flue gas desulphurisation, is an ideal raw material for cosmetic face masks. In the first step, the active ingredients are applied pure or in the form of gels or creams and then covered with a freshly mixed aqueous slurry of the mineral. By absorbing water, calcium sulphate hydrate is formed, which hardens in a short time. The resulting occlusive, penetration-enhancing covering can be peeled off at the end practically in one piece.
However, care should be taken to ensure that the material does not come into direct contact with the skin, if possible, in order to avoid the reaction with the fatty acids of the skin barrier described above.

Food supplements

The calcium and magnesium required by the body are absorbed through drinking water, mineral waters, plant and animal food. Deficiencies are therefore rare. Both metals perform a variety of functions in the body, including the nervous and immune systems and muscle cells. Therefore, it can be useful for athletes to take magnesium salts such as magnesium citrate to prevent muscle cramps.
Furthermore, it is no secret that magnesium salts have a certain sedative effect, for example in nervous disorders. Calcium plays a role in blood clotting and in the vitamin D balance, for example.

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