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GEO-NETWORK OF LATINAMERICAN-GERMAN ALUMNI (GOAL)

CONTENT

1. Editorial Note

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Dear friends, dear GOAListas, liebe Freunde, caros amigas y amigos,

This year 2020 could become a historical event year. It is for the first time in human history that a pandemia can be observed basically in real time (https://coronavirus.jhu.edu/map.html). And yet those numbers, be it of affected persons or of dead are not at all free from partly major errors; some deliberate, others due to other boundary conditions. No, I am not going to start a medical discussion with you – I use this pressing issue to illustrate the relevance and value or reliable data. In the geosciences, we depend just as much as in medicine, in physics, sociology and other fields of science on high-quality data. And it does not end there – uncompromised quality is a prerequisite, not a value in itself, for testing robust hypothesis and for coming up with meaningful and corroborated arguments and interpretations.

Quite some of us GOAListas received their academic education at times, when much of the geosciences were still largely descriptive and when working with computer was in its infancy. While most of us have adapted, there still is lots to be desired. Those of us, to whom computer literacy and working with larger datasets is much more familiar from the start, may face other challenges, e.g., gullibility.F

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Following the disappointing rejection of our two previous DAAD proposals to support joint GOAL activities, we brush off the dirt, have licked the wounds and will now retry. Since it appears non-feasible to apply for two consecutive years this time, we suggest to now apply for Germany 2021 – and hope that to the end of this year, there will be concrete ideas and an invitation from at least one of our Latin American groups to host a subsequent GOAL event somewhere between Mexico and Cuba and the southern tip of the continent. Please discuss this with your national coordinators and come forth with ideas. Your ideas can be coarse and in its infancy – we sure are ready to assist in developing a successful scheme.

The event in Germany shall run under the title “DIGITAL EARTH SCIENCES: FROM FIELD TO PUBLISHING” and take place from September 12 to 18, 2021. Key location will be Freiberg for the workshop and course, plus several places between Saxony and the Harz mountains during the anticipated excursion. Please express your serious interest as soon as possible and consider your active contribution, ideally something that fits well under the wings of the key topic. Yet, no worries, we will take care of other topics, too. And Ladies, get to the front – it is not just because of formal demands that we wish to give you a platform.

Dear Friends, we know about the waxing and waning of continents, the build-up and wear-down of mountains, formation and dry-up of lakes and rivers, the coming and going of species over evolutionary times. Yet this may be of limited consolation, when you or loved ones worry about the corona virus and Covid-19. We humans can do lots to reduce risks, but we have to live with them. Ideally, we learn not only how to creatively and balanced to cope with pandemias but also to tackle the other, much larger challenges that we subsume under the terms of global change and climate change. And it is there that we can contribute and help sustain our planet for the future of humanity.

With all good wishes and looking forward to seeing you soon – Abrazos y abraços, sowie eine dicke Umarmung

2. Speleothem chemistry
First part:
Speleothems formation. Evaluation of time-space-related physical-chemical processes.

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Abstract
Speleothems occur in almost all caves in limestone and often also in caves and cavities on other substrates such as silicate, evaporitic, ferruginous or magmatic (SL) rocks. In limestone sl, their formation is a product of water-rock reactions with low pH and high CO2 content, dissolution process and precipitation directed by a set of physical, chemical and biological properties. This work attempts to organize the sequence of the formation of speleothems and suggest environments and processes of its formation, as well as attempting to suggest possible applications of the information contained in its physical and chemical specification. In Limestone, rocks are water-host rock-atmosphere interaction products with low pH and high CO2 content, dissolution process and precipitation directed by a set of physical, chemical and biological properties. This work attempts to organize the sequence of the formation of speleothems and suggest environments and processes of its formation, as well as attempting to suggest possible applications of the information contained in its physical and chemical specification.

Key words: Cavern; karstic environment; speleothems; conditioning factors; chemical composition

Introduction
The investigation of speleothems normally is connected directly to the evolution of caves, their climate situation, age, changes in water levels and use of prehistoric populations.

This text will show that the great variety of properties of speleothem formation allow a wide field of application in geomorphology, climate and environmental sciences.

A good and extent exposition of karst evolution, processes end geneses is given by Ford & Williams (2007).

Definition:
Commonly known as cave formations, are secondary mineral deposits formed (SMD) in caves. The term "speleothem" as first introduced by Moore (1952), is derived from the Greek words *spēlaion* "cave" + *théma* "deposit".
Speleothems take various forms, depending on the water movement. Types of speleothems include:
-**Dripstone** is calcium carbonate in the form of stalactites or stalagmites.
-**Stalactites** are pointed pendants hanging from the cave ceiling, from which they grow.
--**Soda straws** are very thin but long stalactites having an elongated cylindrical shape rather than the usual more conical shape of stalactites.
--**Helictites** are stalactites that have a central canal with twig-like or spiral projections, appearing forms as ribbon helicities, saws, rods, butterflies, hands, curly-fries, and "clumps of worms".
--**Chandeliers** are complex clusters of ceiling decorations.
--**Ribbon stalactites** are shaped accordingly.
-**Stalagmites** are the "ground-up" counterparts of stalactites.
--**Broomstick stalagmites** are very tall and spindly.

--Totem pole stalagmites are also tall and shaped like their namesakes.
Fried egg stalagmites are small, typically wider than they are tall.
--Calcite circles are small rings formed around stalactites
--Columns result when stalactites and stalagmites meet or when stalactites reach the floor of the cave.
Flowstone is sheet like and found on cave floors and walls.
-Draperies or curtains are thin, wavy sheets of calcite hanging downward.
-Bacon is a drapery with variously colored bands within the sheet.
-Rimstone dams, or "gours", occur at stream ripples and form barriers that may contain water.
-Stone waterfall formations simulate frozen cascades.
Cave crystals
-Dogtooth spar are large calcite crystals often found near seasonal pools
-Frostwork is needle-like growths of calcite or aragonite.
-Moonmilk is white and cheese-like.
-Anthodites are flower-like clusters of aragonite crystals.
-Cryogenic calcite crystals are loose grains of calcite found on the floors of caves. Possibly be formed by segregation of solutes during the freezing of water.
Speleogens (technically distinct from speleothems) are formations within caves that are created by the removal of bedrock, rather than as secondary deposits. May be formed during processes of primo and prekarst processes or during the movement of great amount of flowing water. These include, Pillars, Scallops, Boneyard or Box work.
Other particular forms
-Cave popcorn are small, knobby clusters of calcite
-Cave pearls are the result of water dripping from high above, causing small "seed" crystals to turn over so often that they form into near-perfect spheres of calcium carbonate.
-Snottites are colonies of predominantly sulfur oxidizing bacteria and have the consistency of "snot", or mucus.
-Calcite rafts are thin accumulations of calcite that appear on the surface of cave pools

Speleothems in this environment normally are made of pure calcium carbonate are a translucent white color, but often speleothems are coulored by chemicals compounds such as iron-, copper- or manganese oxide, or may be brown because of mud and silt particulate inclusions.

Occurrences:
Speleothems are common in caves around the world. They usually form when the finalization of the formation of primo- and prekarst lead to a real karstic system, allowing a relatively free flow of water and air. They form normally in the endocarstic system.

Speleothems are described from a lot of different environments and hostrocks, like geo-hydrothermal systems (Temovski et al., 2013), sulfur acid environments (Waele et al., 2016), confined systems (Klimchouk, 2005), evaporitic environments (Stafford et al., 2008; Waele et al., 2017), salt stocksformations (Frumkin, 2013; Moseley, 2017) or confined tectonic systems (Enne-Silva, 2015).

In this text are only treated speleothems formed in caves from the interaction of carbon dioxide rich water, penetrating from the surface and enriching in Ca^{++} and less Mg^{++} often up to saturation, creating the exokarst and reached the open cavern system along fractures, channels or other viabilities. There a reduction of solubility causes precipitation of carbonates in the different forms, due to the environmental conditions.

Another important possibility is the opening of a suspense porous ground water level by the forming galleries. They cut these rocks, which may leave to a liberation of the water by shower/rain-like phenomena and its typical forms (Kazemi, 2012).

The surface vegetation often plays an important role in the support of CO_2-rich water, especially in cold regions or mountainous regions

Chemical composition:
In the literature are described a lot of different speleothems of a wide chemical field of composition. The chemical composition is a function of the host rock composition, climate influenced water composition and the intensity of processes.

The composition is normally a function of host rock chemistry in which the caves are formed, water composition and peculiar relation between mineral chemistry and environmental conditions.
The number of minerals, which can form speleothems under normal conditions, is limited. The greater amount needs very special conditions of chemical factors, environmental/climatic situations and peculiar geological situations.

More or less complex dissolution-precipitation interactive processes form all these structures.
In this case, carbonate speleothems, the system is relatively simple and formed by CaO, MgO, CO_2 and H_2O and minor quantities of metals incorporated in carbonate.

Contamination with other possible precipitates may influence in the conditions of formation processes.

Importance:
Due to the formation of these forms, they may be important indicators of physical-chemical factors environmental evolution such as:
a. Indicate of external climate and the situation in the cave by the distribution of the stable isotopes.
b. Indicate the evolution of the pre-karstic- and karstic processes.
c. Indicate changes in the intensity and directions of water availability.
d. Changes in the physical structures of the cave system.
e. Changes in environmental evolution, paleoclimate changes on the surface (Gascoyne, 1992).
f. Airflow indicators.
g. Dating of karstforming and other genetical processes (Gascoyne et al., 1983).

Formation:
The formation of speleothems is conditioned by several basic factors like availability of water, salts (eg. $CaCO_3$), dissolution evaporation and dissolution.

Water can be obtained in different ways and the quantity and composition determines the possibility of formation (figure 1). Similar observations are described by Derek Ford & Williams (2007) for the formation of calcitic structure.

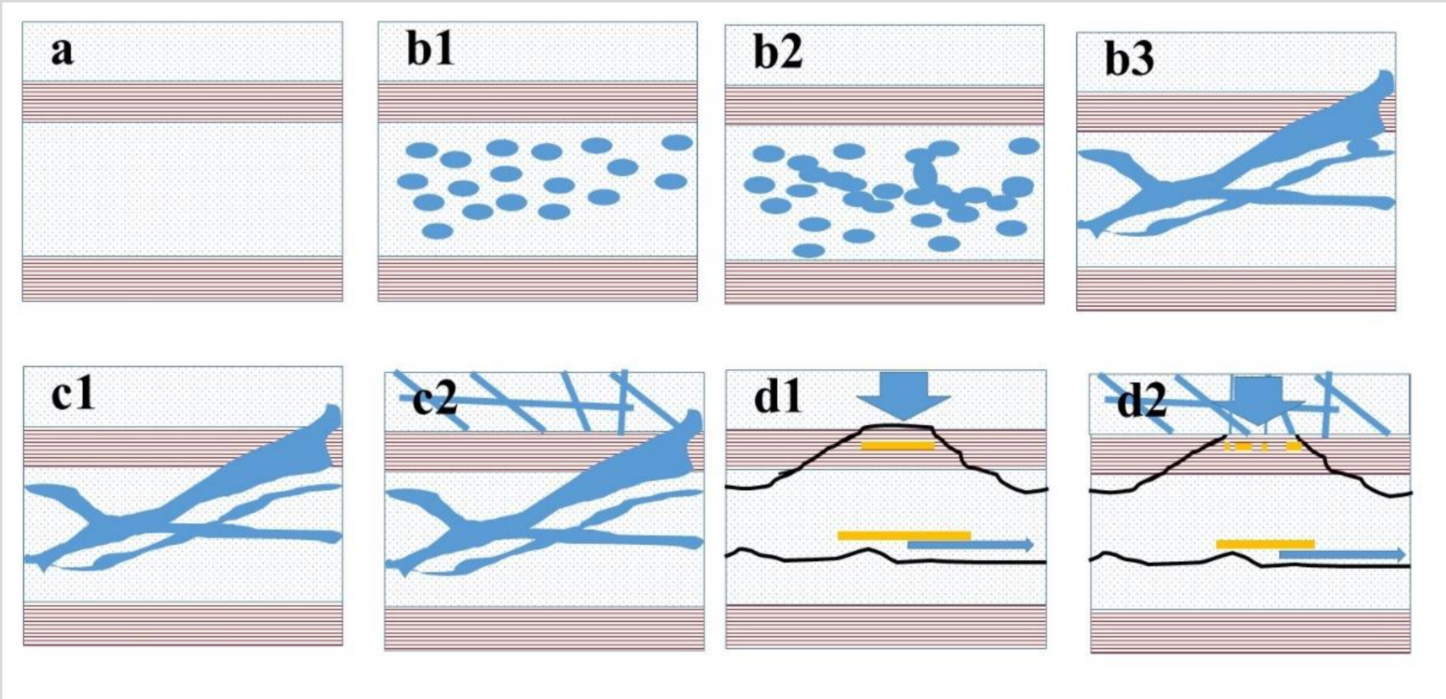

***Figure 1**. Schematically view over the possibility of water entrance in the system and the connection with speleothem formation. blue: water filled open spaces; yellow: Localities of speleothem formation; blue arrows: direction of water movements; a. Geological situation at the cave formation site; b. 1, 2, 3: Opening of the karstic system by formation f round dissolution bubbles in the rock and their interconnection until free water movement occurs; c. 1: Entrance of Ca-rich water by opening of a porous water horizon above the system; 2: Entrance of Ca-rich water by opening of a subsurface fractural water horizon or fractures connected to the surface; d. 1: Water entering from the porous water layer; 2: Water entering from the fracture system; With the connecting of the galleries to the air, intense speleothem formation may initiate.*

The availability and the spatial distribution in the system of water may influence over the form, quantity and occurrence of the speleothems.

Basic physical-chemical concepts of speleothems formation:

The main processes of formation of speleothems is based on the balance of the chemical system H_2CO_3 - $CaCO_3$ - CO_2 - H_2O, with their solubility and precipitations processes according to physical-chemical environmental conditioning and the induced evaporation processes sl. (figure 2).

The solubility or not of carbonate sl is strongly linked to the chemical properties of the water involved, such as pH, fugacity, dissolved gas content (>>CO_2; <SO_2), dissolved salt load and as well as to physical properties such as temperature, pressure and crystal size, texture and structure of the evolving forms and its chemical composition.

A reversible reaction occurs when you can turn the products back into the reagents. This type of reaction enters into chemical equilibrium when the rate of development of direct reaction, that is, the reaction with reagent consumption and product formation occurs at the same speed as that of the reverse reaction - formation of reagents and consumption of products. These types of reactions in balance are widely seen in everyday life, also in cave environment.

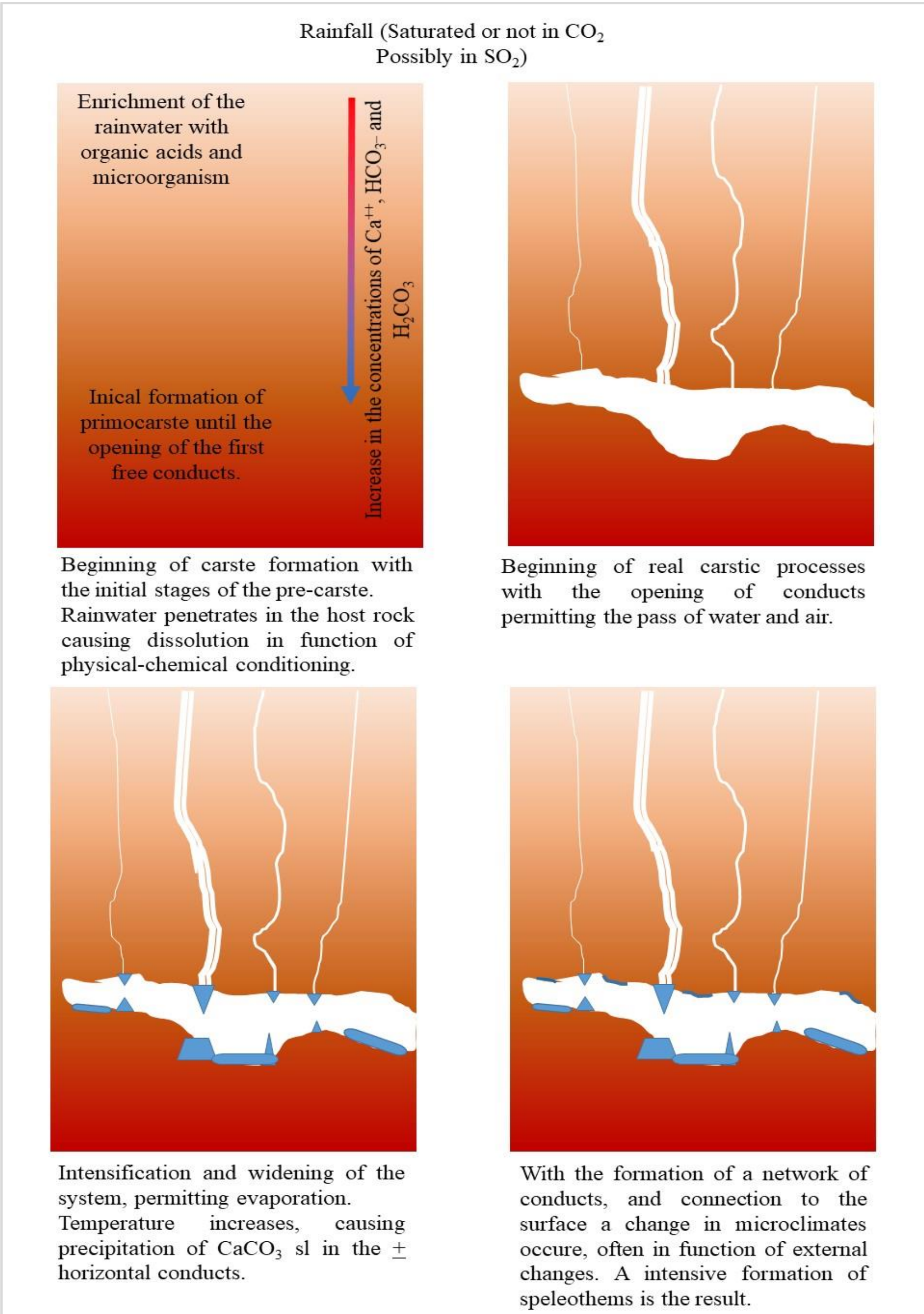

Figure 2. *This figure show the theoretical evolution of speleothems from the beginning of the karstic stage.*

An example is what occurs in caves, in the formation of stalactites and stalagmites. Rainwater or groundwater is subjected to higher pressures and lower temperatures, so it can dissolve larger amounts of carbon dioxide (CO_2) and soils and substrate containing limestone ($CaCO_3$(s)) can dissolve in it, in a function of CO_2 partial pressure, forming cavities. When the water reaches open spaces, CO_2 may be liberated, the dissolved carbonate may be precipitated, and the speleothems are formed.

The principle equations that determine dissolution (1) or precipitation (2) are:

$$CaCO_3(s) + CO_2(g) + H_2O(l) \rightarrow Ca^{2+}(aq) + HCO_3^-(aq)$$

$$Ca^{2+}(aq) + 2HCO_3(aq) \rightarrow CaCO_3(s) + CO_2(g) + H_2O(l)$$

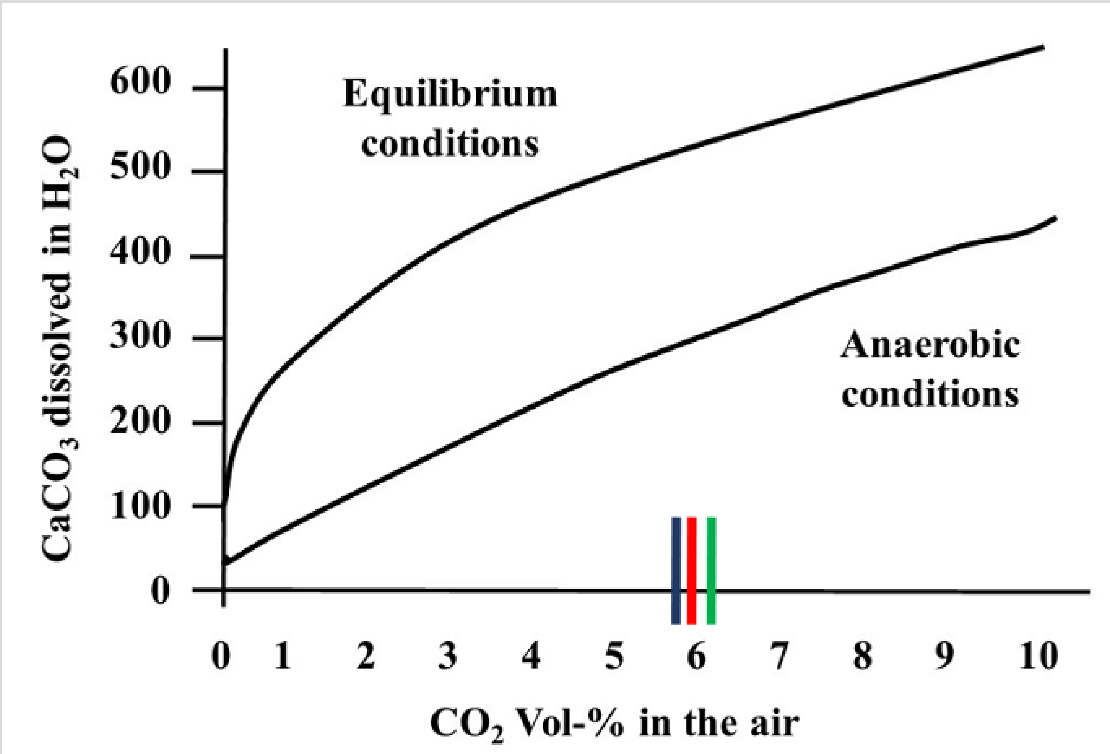

Figure 3. *Chemical processes of dissolution and precipitation causes connected to the CO_2 equilibrium between water-air-rock. Changes influences principally the formation or not of speleothems.*
Cambrium period ▬ ; Quaternay period ▬ ; today ▬ .

The precipitation processes caused by evaporation are regulated by surface factors and their variation, like, medium humidity (%), absolute and Δ temperature, wind speed and direction, concentration of solutions and eventually biological activities.

After the continuous formation of mineral rich water droplets at the roof of the cavern, the dissolved gas (CO_2) and then the water evaporates, liberating slowly the before dissolved carbonates.

These processes shift the chemical balance in the opposite direction (left part of the equation) and $CaCO_3$(s) is formed, often as stalactites in the ceiling of the caves. Also bigger drops, still rich in Ca^{++} and HCO_3^- are falling, deposited at the bottom of the cave, forming stalagmites.

Banks, E.D. & Barton, H.A. (2009) enforces the importance of microbiological activities in the formation processes of speleothems. Ford & Williams (2007) mentioned and gave examples for the importance of CO_2 pressure in speleothem formation and structure.

Detailing the chemical processes and its conditioning:
Figure 3 shows the fields of ions based on $CaCO_3/H_2CO_3$ in the pH-eH diagram. These diagrams show the behavior of Ca, Mg and CO_2 under different pH and reduction or oxidation conditions in H_2O/O_2 environment. It is relatively easy to obtain information about the speciation of these compounds and in this way about their physical-chemical speciation.

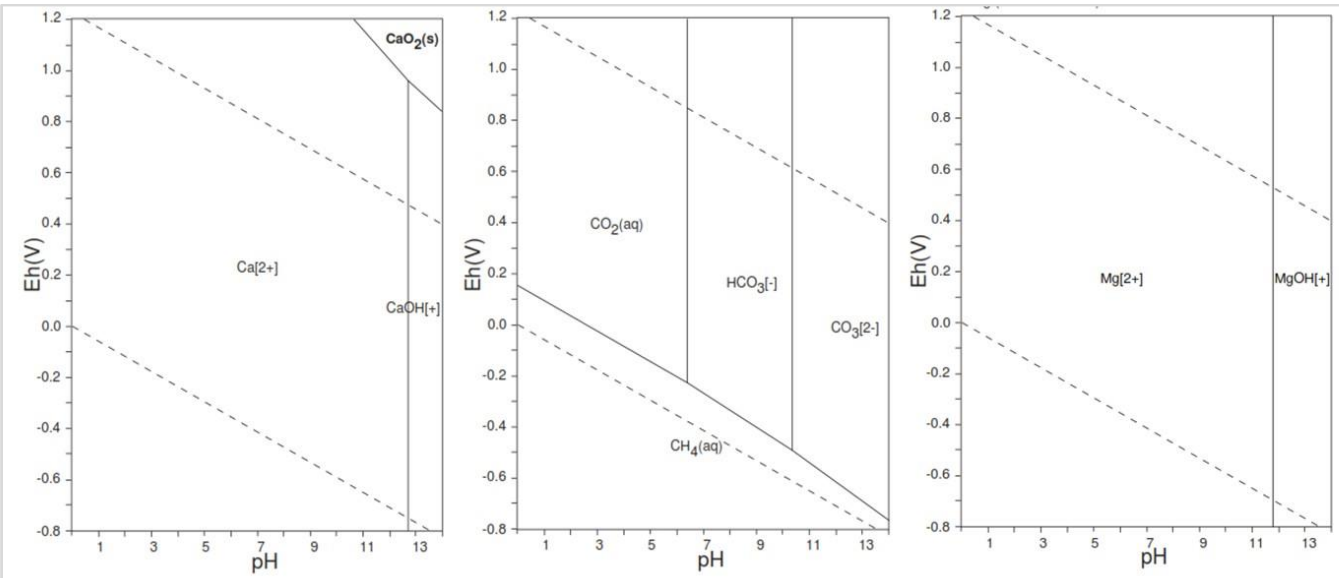

Figure 4. *Here are shown eH-pH diagrams for Ca, CO_2 and Mg at surface conditions. Different environmental conditions influence the precipitation, solidification processes and the chemical composition of speleothems.*

The main processes and its chemical equations are:

a. The equilibrium reactions of CO_2/H_2O:

$CO_2 + H_2O \longleftrightarrow H_2CO_3$

$H_2CO_3 + H_2O \longleftrightarrow HCO_3^- + H_3O^+$ pks ~ 3.88

$2HCO_3^- + H_2O \longleftrightarrow CO_3^{--} + 2H_3O^+$ pks ~ 10.5

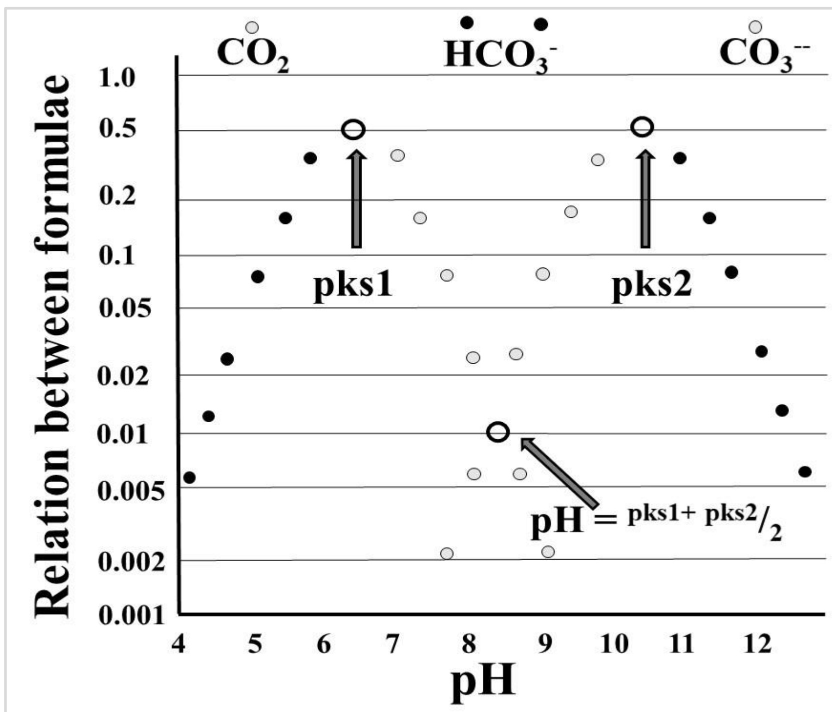

Figure 5. *Dissociation curves for the equilibrium $CO_2 – H_2O$ under atmospheric conditions.*

b. Dissolution and precipitation of $CaCO_3$:

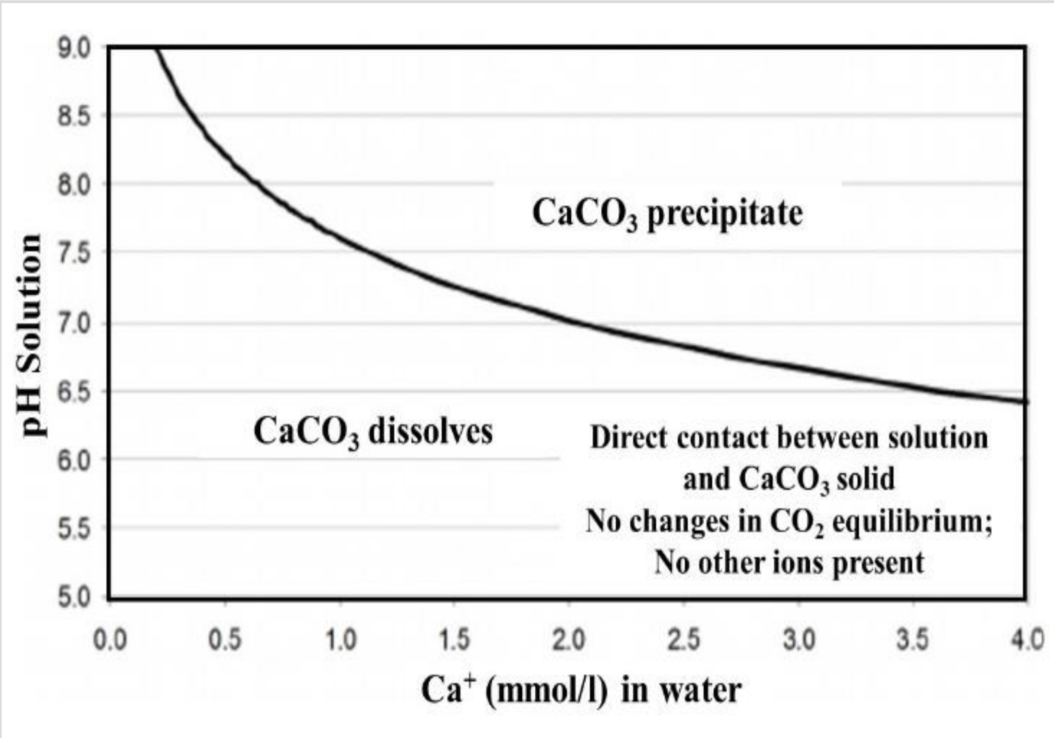

Figure 6. *Equilibrium between precipitation and dissolution of $CaCO_3$ in function of pH and Ca concentration in the solution.*

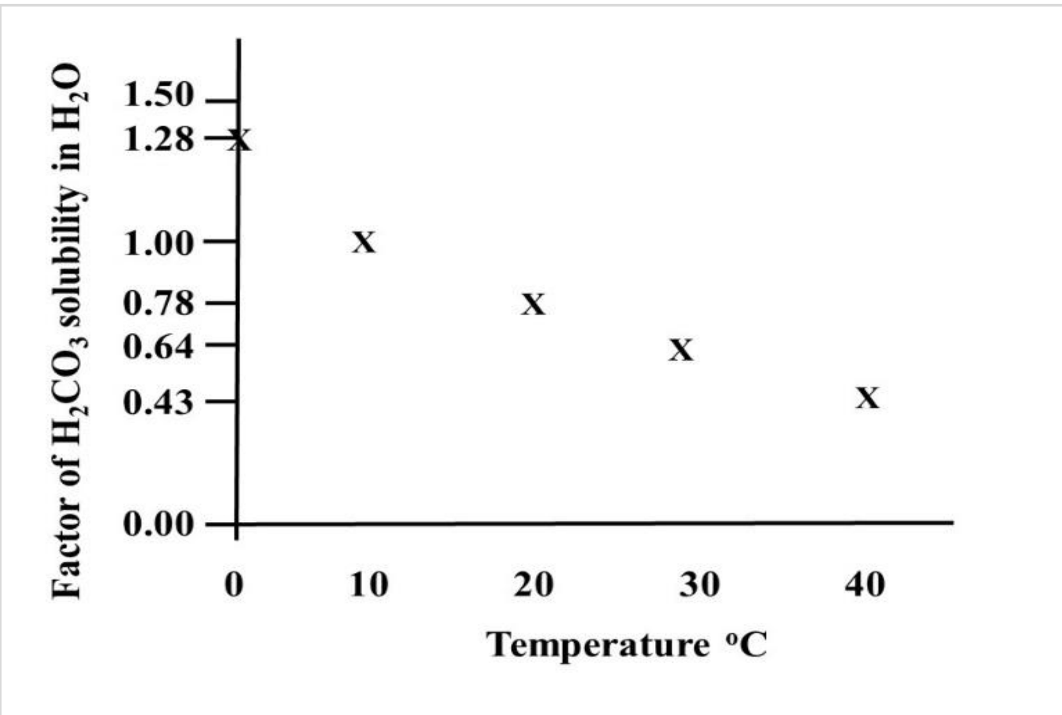

Figure 7. *Relation between gas dissolution and temperature in water.*

c. Late crystalline and chemical transformations in speleothem composition

Equilibrium Calcite – Aragonite:
Calcite is the most frequent deposit in caves. It occur normally as crystalline chemical deposit in the form of sinter or travertine, by the loss of CO_2. A more rare form is tuff, formed by rapid evaporation of salt rich solutions.

Aragonite is under surface condition normally metastable. Every small change transform it in calcite. Still in discussion, this the formation of aragonite may be restricted to special environmental conditions or to an involvement of microbiological life.

Higher concentrations of Mg and some other elements (eg. Sr) like temperature above 50ºC favors the formation of aragonite.

Some cells can also synthesize aragonite under other, not equilibrium conditions. Therefore the involvement of organic matter in the formation of metastable aragonite may be very possible.

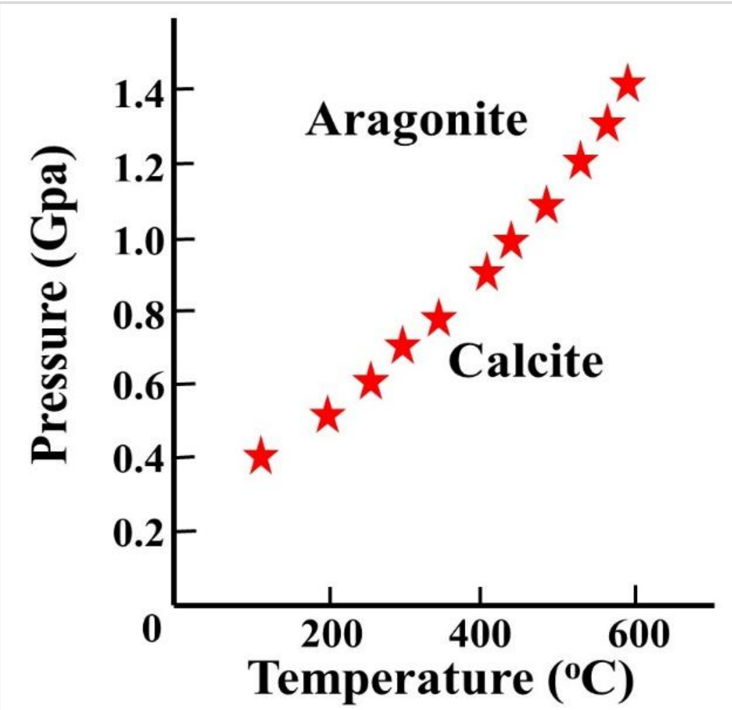

Figure 8. *Reaction between Calcite and Aragonite stability in p-t diagram. Experimental data from various researches.*

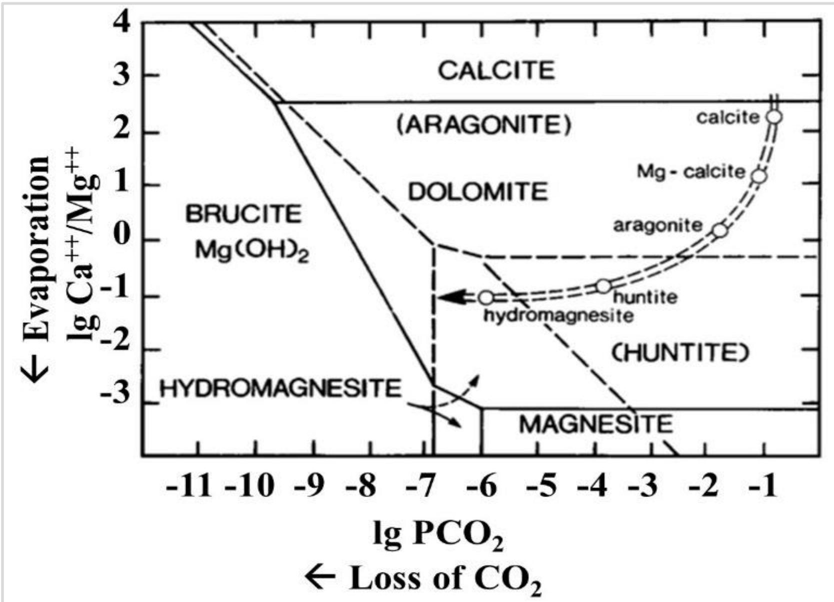

Figure 9. *The figure show the system Ca-Mg-CO_2-H_2O. Stable phases (line) metastable faces (dashed line). A possible evolution of the hypothetical water path during formation is indicated. The relation between evaporation and loss of CO_2 may influence. Temperature and organic matter are not considered (source: Ford & Williams, 2007).*

Substitution of elements and compounds by late processes and after the principal precipitation of speleothems:
During the evolution from active karst to paleokarst sl. the possibility of chemical and physical changes, show a wide field. These changes may be influenced by changes in the water composition that passed occasionally in the conducts. Changes in biological activities by microorganism, changes in overall climate conditions or caused by tectonic activities.

Detailing of the physical processes and reactions:
a. Heating, surface magnification and impact evaporation:
In addition, important factors are the elevation of temperature when drops entered a space, the increasing of surface by "ballooning". Cohesion and the form of the producing pathways determine principally the dimension and form geometry of the drops.

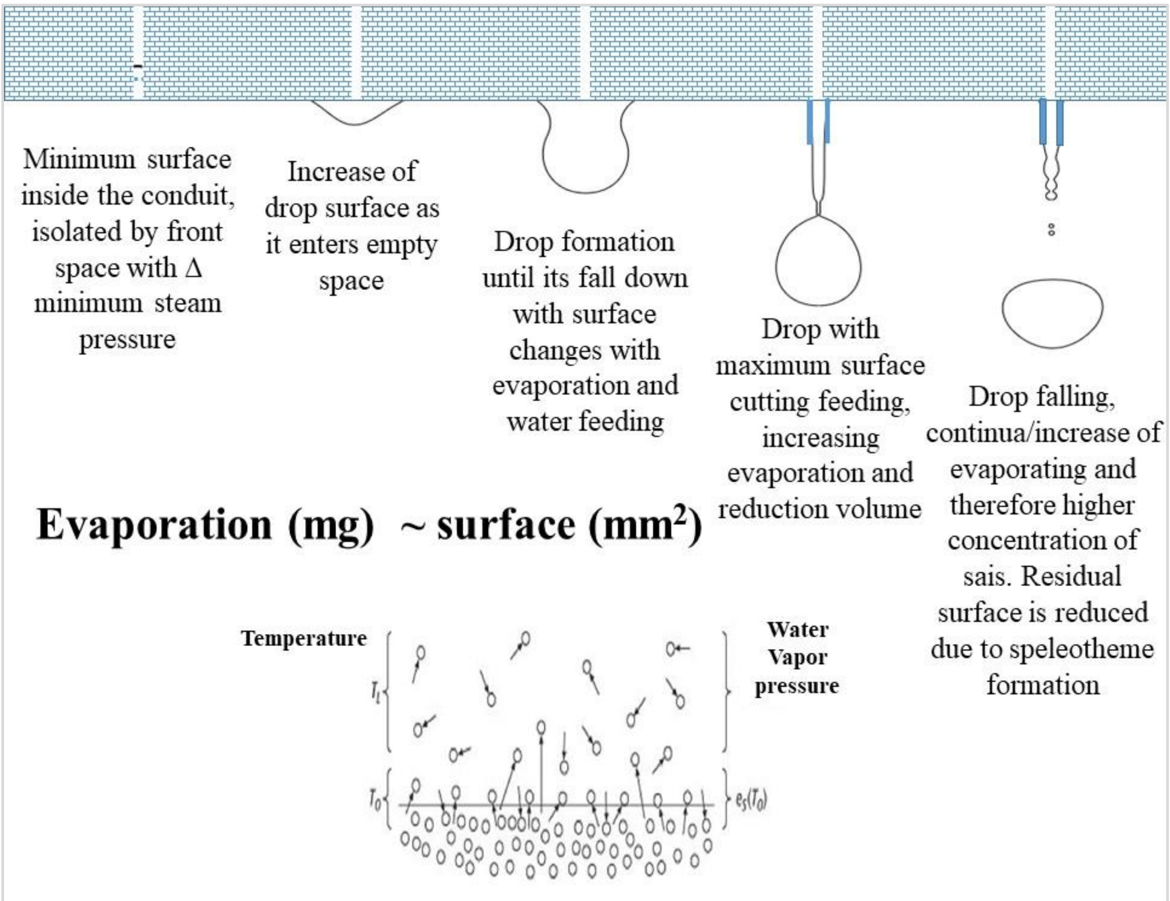

Figure 10. *The evaporation is directly proportional to the surface of the drop, saturation and temperature difference between cave and drop. The form changes during it lifetime.*

b. Changes in temperature:
Temperature has a strong influence over dimension and composition of the speleothems by regulation of water and air saturation with H_2O and CO_2. In caves with periodically low temperature (>0°C), the formation of speleothems may be restricted to the warm period or the open part of the cave.

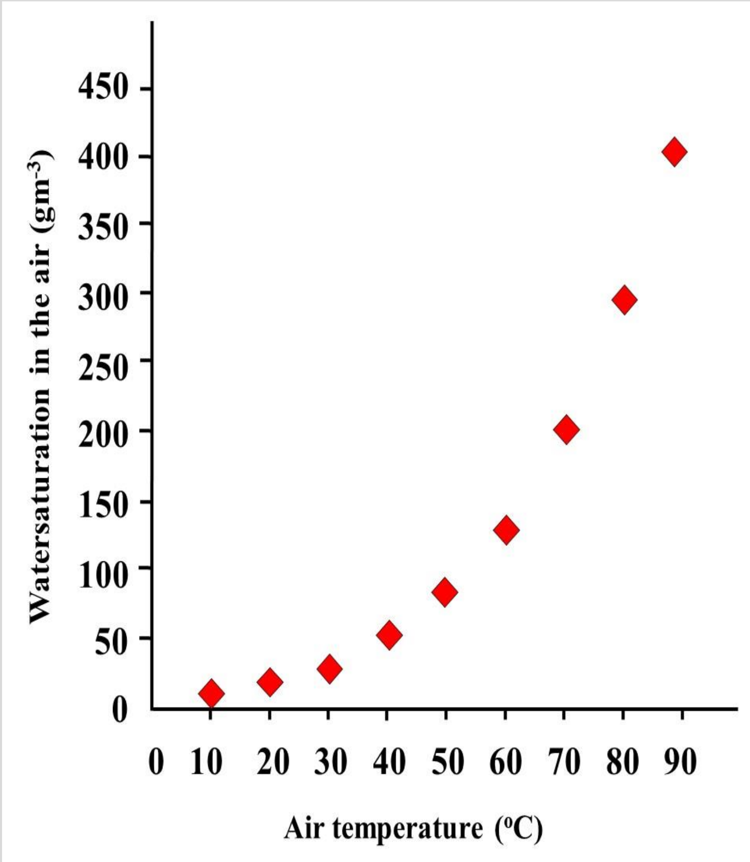

Figure 11. *The temperature is an important factor for evaporation intensity. The curve show the relation between water concentrations in air and temperature evolution. This may explain some differences in speleothem formation in climate zones.*

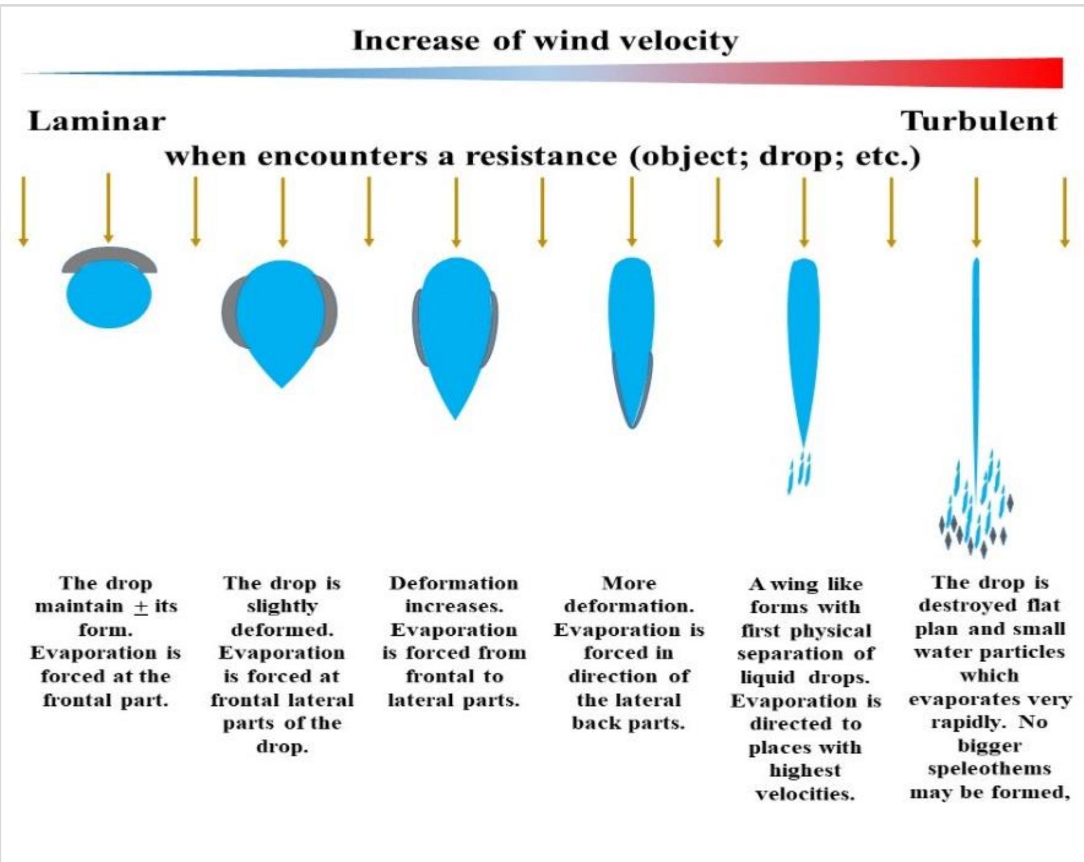

Figure 12. *The velocity and direction of the air currents determines the type of flow, laminar or turbulent, velocity and spatial changes in velocity. These alterations are important for evaporation and deformation and alignment of the forming drops. This behavior of wind together with water disposition determine the form and the direction of increase of the small speleothems.*

d. Water quantities participating in these processes of speleothem formation:
More water increases the flux velocity, causes less relative evaporation and permit the dislocation of the drops by physical pressure like gravity, wind velocity and direction.

The quantity of water together with temperature, CO_2 concentration and flow velocity determines first the dissolution of carbonate and then the precipitation conditions. There exist no detailed investigation about this relation.

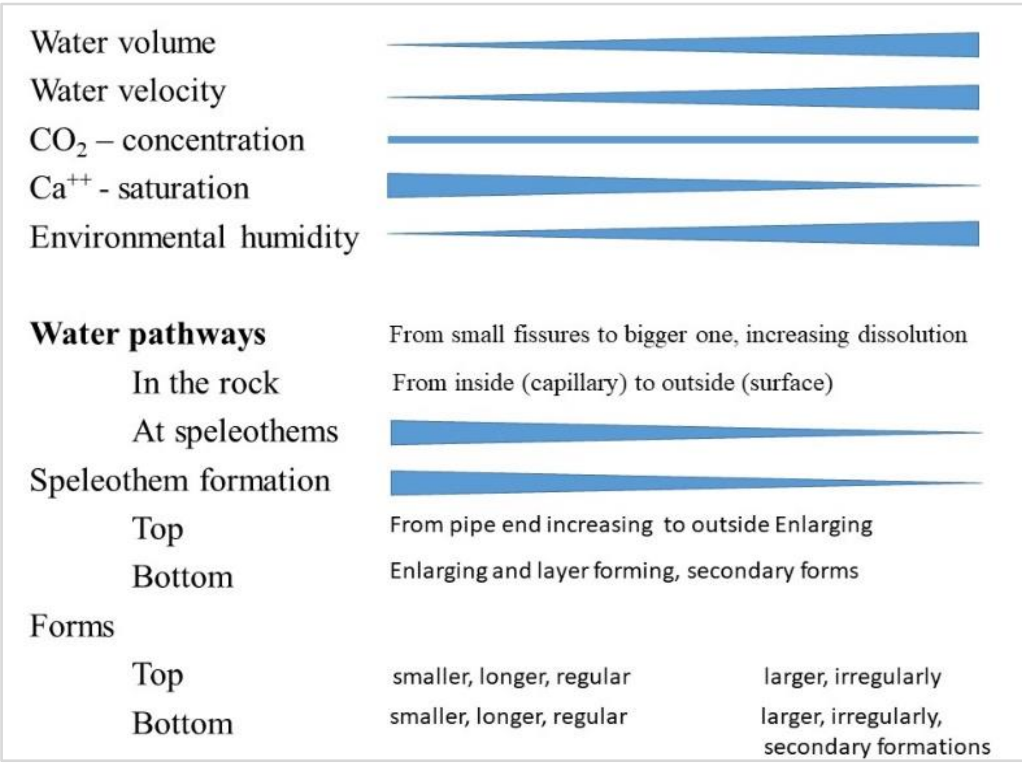

Figure 13. *Relation between water quantity, Ca-concentration and degree of evaporation. Estimated quality of changes based on observations from other sciences.*

e. Microbiological activities:
Many authors (Pentecost, 1994; Contos, James & Holmers 2001) describe the presence of microorganism (bacteria; fungus) in the interior of caves.

This organism have sure an influence about the conditions of water and air composition and the composition of the formed mineral crystals.

Detailed studies are in forthcoming.

Observed results:
When comparing several caves in limestone sl in different parts of the world and formed under varied climates, can be observed also different conditions for the formation of speleothems.
It is observed generally, when speleothems occur, a sequence with well-determined development styles.

The building of these forms is initially always linked to water viability passing through the ceiling rock. In this case faults, fractures, very small fissures, permeable contacts between inclined layers or simply dissolution conduits in their various forms, which allow the installation of speleothems.

a. Initial formation of stalactites and stalagmites sl:

After the installation of empty open spaces begins the water to drip from the ceiling, forming stalactites and where impacts stalagmites according to the chemical composition of water, the height of free space, orientation of water current in the bottom or not.

The expressiveness of these formations depends on the overall concentration of $CaCO_3/H_2CO_3$, water amount, trim altitude, "climatic" conditions and gas saturation in the empty space.

These shapes are usually well aligned and vertically, with the upper shapes thinner and longer than the lower shapes, which are more compact and irregular. This interface may be expressed by a function of the relative humidity and gas content of the empty space of the conduit and the available amount of running water.

Table 1. *Principal factor that influences the formation of these speleothems*

Volume of the open system
Velocity of connection to surface
Velocity of connection to atmosphere (number of connections)
Water quantity from surface
CO_2 – pressure in the system
Composition of penetrating water
Temperature distribution in the system (air; water; substrate)
Pressure conditions in the system
Water saturation in the system

b. Continuous carbonate covers (e.g. "draperies") sl:

Continuous layers of $CaCO_3$, calcite or aragonite, are formed when varied amounts of water, penetrating the roof rock sl and passing over the walls or the bottom of space by raining or by surface flux.

Chemical transformations will occur or may not occur due to the evolution of temperature and/or participation of microorganisms. These layers can occur from the roof to and at the base in function of water discharge and relative moisture of the conduct atmosphere.

Table 2. *Factors and conditions, which determines the formation of these covers:*

Inclined substrates
Greater continue water quantities
Greater surface
Lower salt concentration in the water
Lower evaporation in the cave
No surface enlarging
No turbulent, but laminar flow
Possibility of water accumulation
Higher localized salt precipitations

c. Speleothems of the open karst stage and precipitation under late karst conditions:
These speleothems show in their forms clearly the influence of air movement within the open space of the conduit.

These morphological forms cover a wide field of variations with its orientations according to the direction and strength of the existent airflows.

The “wind” can be laminar or turbulent, one-way or multidirectional, stable or showing great variation in directions, strength, space and time.

Table 3. *Factors, which determine the evolution of these late speleothems:*

Large open cave system
Complex interconnected viabilities
Often more than one/two connections to outside
Strong interconnection between annual changes and cave climate
Intensive changes in wind velocities and current directions
Complex interconnections between different air flux sources
Complex physical system creates complex internal climate situations
Possible influence of anthropogenic activities

d. Late and final chemical and physical changes:
The main changes observed are the transformation from aragonite, which may have precipitated into calcite and the maturation of calcite crystals with the increase of these crystals often together with changes in their chemical-structural, like homogenization, purification, elimination of crystal errors etc.

The changes during final stages of karst-formation that can be observed are normally limited to the superficial part of the speleothems or existent fractures, cracks or other cavities in them with access to the environment. Modification of the crystalline structure, exchange of ions for reasons of chemical stability or introduction of compounds transported by airways such as dust, gum, etc. are usually limited.

Often can also be observed corrosion processes in speleothems, caused by the precipitation of under saturated condensates of water/acid by the interaction between internal cave climates with outside conditions (Tarhule-Lips & Ford, 1998; Ford & Williams, 2007).

Tab. 4: *Physical and chemical environmental condition active during these stages.*

Reduction of roof rock extension by intemperism and erosion
Reduction of water quantities from the roof
Reduction of total water amount by lowering of base level and topographical elevation of the system
More free water by physical flux on the bottom of the galleries from higher to lower energy
Exposition of gthe galleries to open air by intemperism and erosion
Changes in the chemical composition of participating water

e. Micro-organism and speleothem formation:
The effects of microorganisms were observed during all stages from the stages of pre-, primo-, through real karstic formations until to the paleo-karst situation (Pentecost, 1994; Lu et al., 2000; Ford & Williams 2007).

They are not yet well studied or little understood, contrary to the poor physicochemical processes.

Table 5. *Principal biological factors the influences the formation of speleothems.*

Changing of pH, eH, chemical composition and conductivity
Dissolution of carbonates
Precipitation of oxides (free or fixed on the wall)
Precipitation of carbonates (free or fixed on the wall)
Formation of precipitates at the contact between free ai and water surface
Sealing of water viabilities in speleothems, porous spaces and fractures
Colonies occupying surfaces, preventing or causing mineral deposition
Causing mineral alteration in existent spaleothems and surface depositions

Some theoretical models for the different types of speleothem formation with real examples:
Here are shown schematic drawings, which are the compilation of many observations in cave systems and active karstic processes corroborated by discussion with many colleagues.

Stalactites:
They form by water passage in an internal canal and precipitation by evaporation/loss and CO_2 at the end. Large amounts of water passing through the surface can disrupt its formation, creating a type of envelope by bypass movements.

Stalagmites:
Forming by the impact of water drops touching on the cave substrate. The concentration of dissolved ions, cavity height, water flow intensity, relative humidity and temperature influence the growth of these structures.
An important factor is the absolute increase in the surface of the pendant liquid after impact.
Its pathway and evolution during fallen determines the geometric shape and direction of growth of the stalagmites.

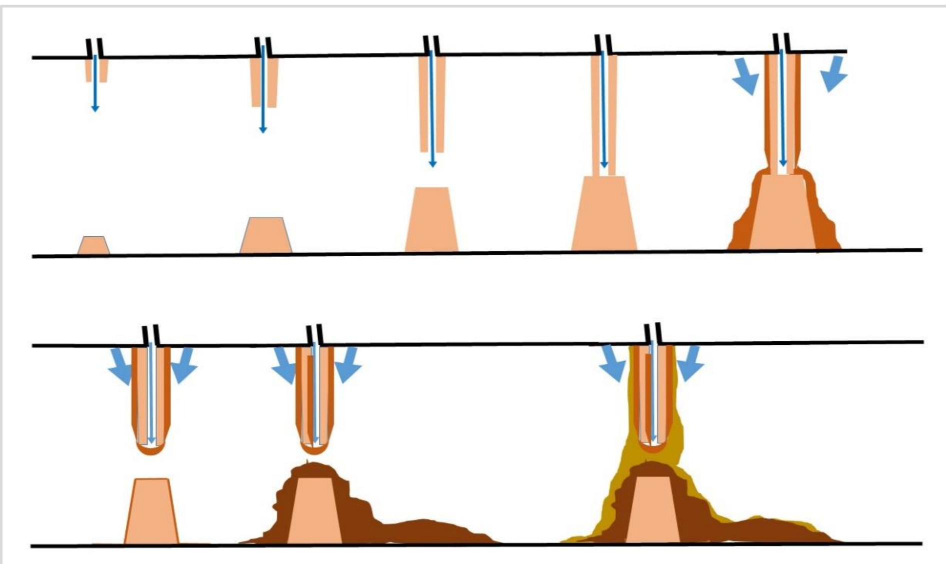

Fig. 14: The figure show the most important effect over stalactite and stalagmite formation.

Irregular fine structures:
These speleothems form under the properties and factors involved in the growth of other speleothems, previously treated. They are very influenced by small changes in water conditions, wind velocity and directions and the annual changes in cave climate.

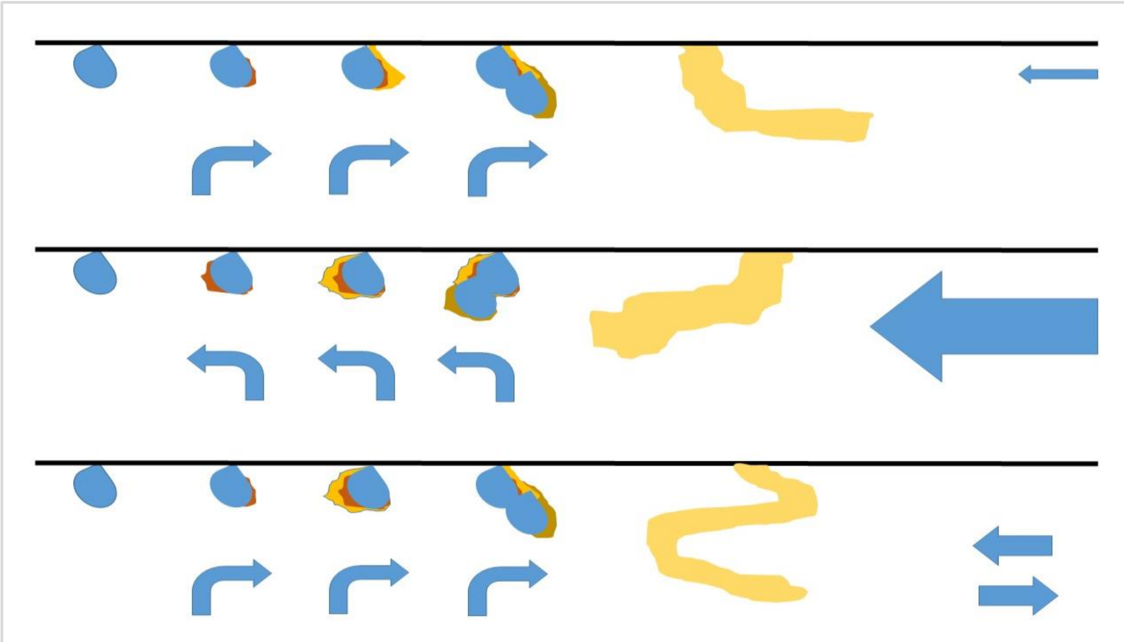

__Figure 15.__ The figure show a systematic evolution of small speleothems (hairs etc.) in function of wind force and direction.

Irregular fine structures:
These speleothems form under the properties and factors involved in the growth of other speleothems, previously treated. They are very influenced by small changes in water conditions, wind velocity and directions and the annual changes in cave climate.

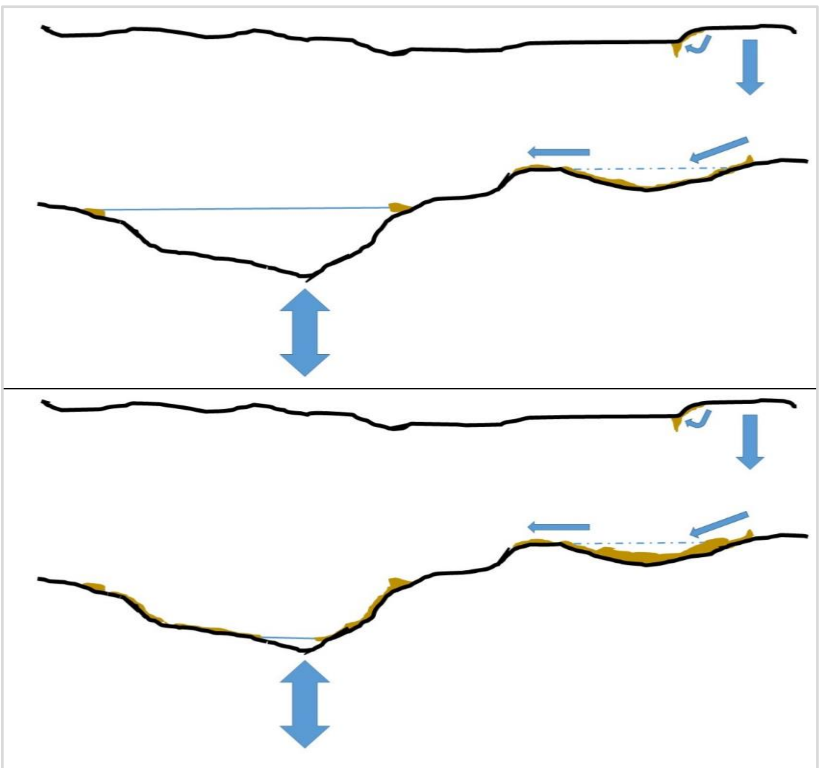

__Figure 16.__ The figure shows the main effects and results of the formation of planar structures (floors; layers; varnish; glaze).
These forms can be built by water injection from down or up using porosities or fracture systems.

Table 6. *The table show a resume of factors, which influences in the speleothem formation in different karst and cave systems. Here is tried to show the influence of outside and inside conditions of karst and cave system, its evolutionary stage, the direction and source of water influx and the importance of the factors together with principal speleothem formation by precipitation or erosion sl. (modified and completed from other authors e.g.: Ford & Williams, 2007; Rodet, com. Verb.; own observations). Infl.: Influence; Dep.: deposition/formation; Eros.: Erosion/dissolution;*

Conditions	Factors I	Factors II	Infl.	How works	Dep.	Eros.	Forms
Water							
	quantity		strong	forming mass	x		all
	composition		strong	forming mass	x		all
		natural	strong	forming mass	x	(x)	all
		hydrothermal	strong	chemical precipitation by supersaturation	x	x	wall, bottom
Air	humpty				x	x	near the mouth
	dust weight	inorganic				x	near the mouth
		organic					near the mouth
Substrate	Soil		strong	water composition	x		all
	Organism			ph, fugacity, solubility	x	x	all
	viability/watermobility		strong	availability of material	x		all
Environment	Temperature (abs; Δ)			evaporation/precipitation	x		all
	Pressure		weak	evaporation/precipitation	x		all
	Air movements	unidirectional		evaporation	x		all
		multidirectional		evaporation	x		all
	organic matter		strong	mineral composition	x		all
			relative	stability of the speleothem		x	all
Conditioning of cave	open		strong	evaporation/precipitation	x	x	all
	closed		strong		x		all, small
	high galleries		strong	evaporation/precipitation	x		all
	on air		strong	evaporation/precipitation	x	x	all
	submerged		strong	principally erosion; e.g. whisker		x	none
	water input	top	relative		x	x	all
		bottom	relative		x	x	stalagmites, plane
	active		strong	evaporation/precipitation	x	x	all

Conclusions:

In short, the following results can be reported:

a. Speleothems are mainly formed after the creation of an open space by dissolution and/or mechanical processes, allowing the beginning of precipitation processes;

b. They are precipitation products of carbonates sl, dissolved by chemical/biochemical interaction during the passage of water through rocks or rarely through porous conduction in denser rocks;

c. Its geometric appearance, like also its growth-conditions" reflect the "climatic" evolution in the conduit, always seen together with the evolution of external factors;

d. Its growth is determined by the available amounts of water, t differences, moisture variation, gas- and water-concentration and composition, location and magnitude of the conduits;

e. Mineral and chemical changes of speleothem composition reflect alterations in the environmental conditions and the properties of its original materials.

f. The chemical and mineralogical composition along principal axes indicate the environmental evolution during its formation;

g. Geographic position of speleothems in a whole cave complex permits evaluation of physical conditions and chemical composition of air, water, substrate rock changes in space and time;

The table 6 tries to give an overview or summery over the conditioning of speleothem formation.

Acknowledgements:
We will thank specially to Prof. Dr. H. Baggio and Dr. J. Rodet for reading the text and for their contributions.

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3. La historia geológica de Cordilleras Sucesivas, contada con el ejemplo de la región norte de Sierra Madre Oriental de México

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La Sierra Madre Oriental (SMO), una de las provincias geológicas más importantes de México, es un cinturón cabalgado y plegado que atraviesa el país desde el Cinturón Volcánico Mexicano en el sur, hasta los estados norteños de Coahuila y Chihuahua, con una longitud de más de 800 km y una amplitud de entre 80 y 100 km (Eguiluz de Antuñano et al., 2000). De acuerdo a Fitz y colaboradores (2017) la SMO es una cuña orogénica de antepaís compuesta por rocas carbonatadas del Jurásico Superior al Cretácico Inferior y estratos de cuenca de antepaís del Cretácico Superior, imbricados y plegados. Estos últimos autores utilizan el término de Cinturón Plegado y Cabalgado de México. La historia del acortamiento del Orógeno Mexicano del cual forma parte la SMO se desarrolló durante el período del Cretácico Superior al Eoceno. En el estado de Tamaulipas, la SMO se caracteriza por amplios pliegues de caja con vergencia general hacia el oriente, en los cuales destacan prominencias morfológicas por las potentes y competentes calizas del Cretácico. Entre las megaestructuras destaca el Anticlinorio Huizachal-Peregrina, localizado al oeste de Cd. Victoria, Tamaulipas, pliegue con orientación general NW-SE doblemente buzante, de casi 80 km de largo y 10 km de ancho (Fig. 1). De tal suerte la SMO corresponde al sistema orogénico más joven de la región, del Cenozoico.

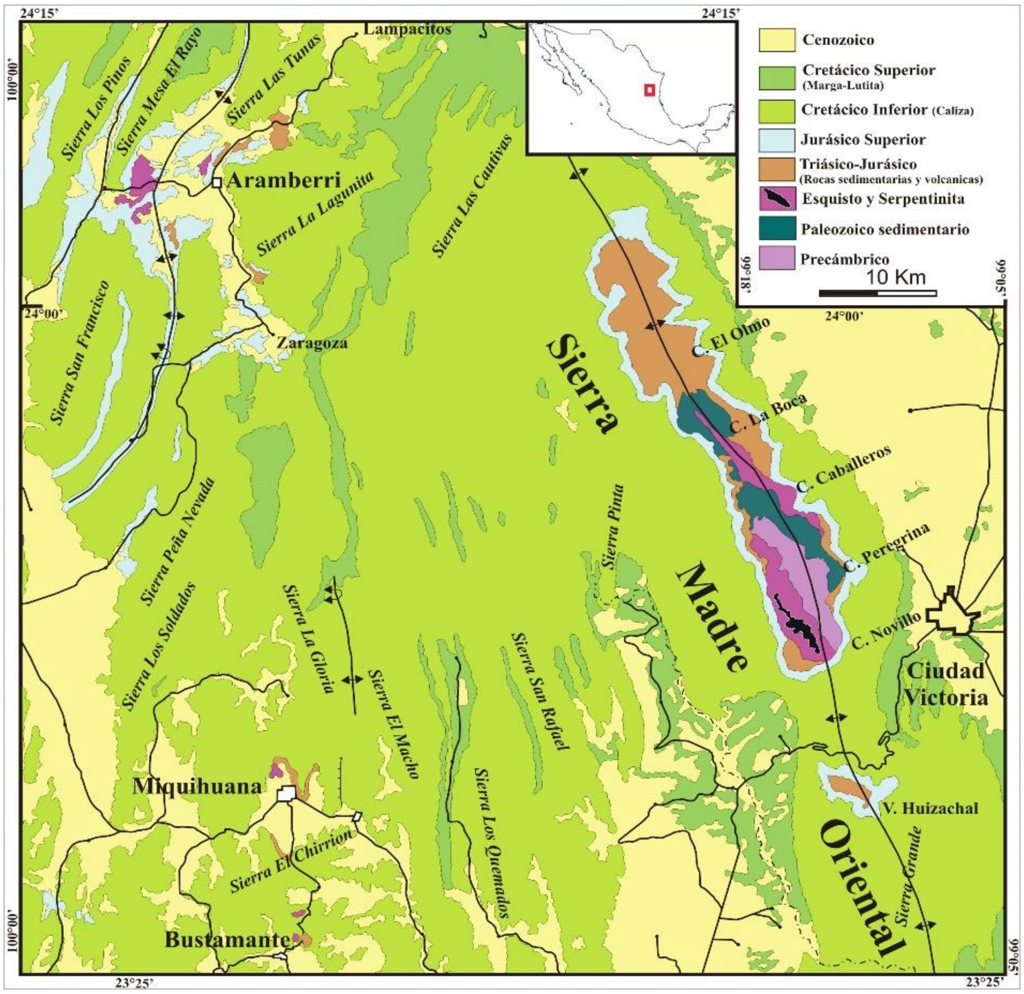

Figura 1. *Bosquejo geológico de la Sierra Madre Oriental, en las cercanías de Cd. Victoria. Se indica especialmente el Anticlinorio Huizachal-Peregrina y su basamento expuesto. Este es el orógeno más joven de la región. Tomado de Barboza et al. (2011).*

A lo largo de los últimos 60 años se han estudiado las diferentes unidades que subyacen al Orógeno Mexicano. Estas atestiguan complicados y prolongados procesos que tienen que ver sistemas montañosos del Precámbrico y del Paleozoico, ahora sepultados. Una de las localidades clave es el mencionado Anticlinorio Huizachal-Peregrina cuyo núcleo ofrece impresionantes afloramientos que precisamente han permitido reconstrucciones paleogeográficas de sectores específicos de los antiguos continentes Gondwana y Rodinia.

Los vestigios más antiguos los conforman las rocas metamórficas del ahora denominado Complejo Metamórfico Novillo (*sensu* Alemán-Gallardo et al., 2019a). Este se compone de un grupo muy variado de rocas como gneises, mármoles, meta-anortositas, meta-granitos, etc. (Fig. 2). Estos se han interpretado como un arco volcánico posteriormente acrecionado a Gondwana y posteriormente sobreyacido por Báltica, generando metamorfismo granulítico de alto grado hace ca. 990 Ma, durante la Orogenia Zapotecana, involucrada en la gestación del megacontinente Rodina. Este proceso llevó a formación del sistema montañoso más antiguo de la región. Este mismo fue disgregado más tarde permaneciendo este sector en la región NW de Gondwana durante el Paleozoico.

Figura 2. *Mármoles de calcosilicatos del Complejo Metamórfico Novillo, que forma parte del primer orógeno de la región. Cañón de la Peregrina.*

En el Ordovícico se gestó un arco continental que se extendió a todo lo largo de la margen occidental de Gondwana, que se expresa en Cd. Victoria como un cuerpo tonalítico (Alemán-Gallardo et al., 2019b). Este representa la expresión más septentrional del Arco Famatiniano de Sudamérica, que en México se denomina Arco Peregrina-Mochoniano. Este sería el segundo sistema montañoso sepultado (Fig. 3).

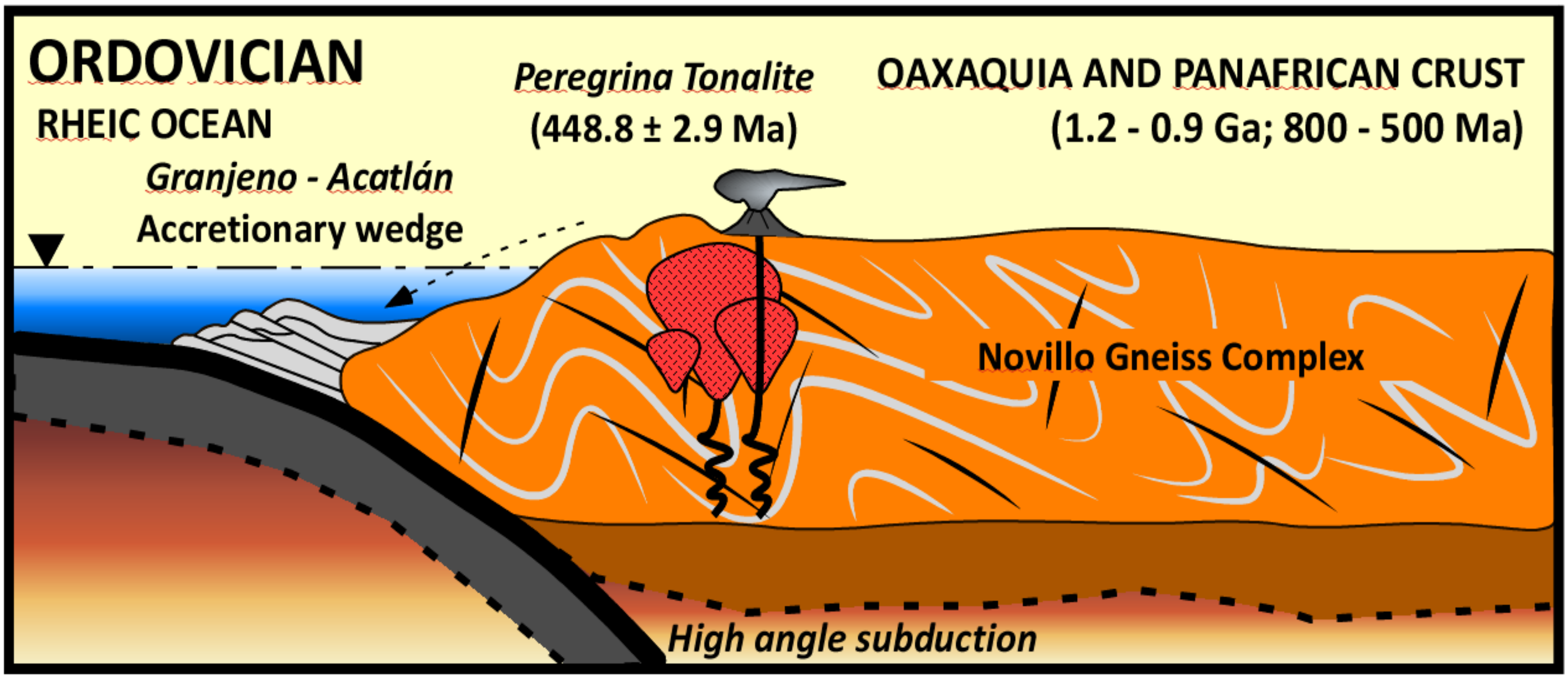

Figura 3. *Modelo esquemático del Arco Peregrina-Mochoniano, origen del Ordovícico. Este corresponde al segundo orógeno de la región. Modificado de Alemán-Gallardo et al. (2019a).*

Durante el Paleozoico, la cuña de acreción de la trinchera de subducción del Océano Paleopacífico fue deformada (Fig. 3), metamorfizada en condiciones de esquistos verdes (Fig. 4), y obducida sobre el Complejo Metamórfico Novillo formando el denominado Cinturón Granjeno-Acatlán (Barboza et al, 2011). Este formaría el tercer sistema montañoso sepultado.

Figura 4. *Detalle de afloramiento de Cañón de Caballeros, del Esquisto Granjeno, atestiguando el orógeno Granjeno-Acatlán del Carbonífero, que corresponde el tercero de la región.*

De tal suerte, en una región de escasos 800 km^2 se encuentran registrados al menos tres antiguos sistemas montañosos del Precámbrico (Complejo Metamórfico Novillo), del Ordovícico (Arco Peregrina-Mochoniano) y del Carbonífero (Cinturón Granjeno-Acatlán), sepultados bajo el cuarto, del Cenozoico (Cinturón Plegado y Cabalgado de México, Fig. 5).

Figura 5. *Panorámica del borde oriental de la Sierra Madre Oriental, que corresponde el cuarto y último orógeno de la región y que sobreyace a los tres anteriores.*

Esta región ha servido en gran medida para ejercicios de campo, excursiones, cartografías, tesis de Licenciatura y Posgrado, que han permitido reconstruir sucesivamente un prolongado período de la historia geológica de México, aunque aún quedan muchas preguntas por responder.

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4. Coordinador GOAL de Colombia obtiene título de Doctor en Ciencias

Por la presente felicitamos a ***Héctor Mora Páez***, ***Coordinador del Grupo de Investigaciones Geodésicas Espaciales en la Dirección de Geoamenazas del Servicio Geológico Colombiano***, por haber obtenido el titulo de ***Doctor en Ciencias en la Universidad de Nagoya***, ***Japón*** el pasado 25 de marzo. La disertación fue dirigida por el prof. Takeshi Sagiya del Departamento de Ciencias de la Tierra y Ambientales y del Centro de Investigación de Mitigación de Desastres de la Universidad de Nagoya y se basó en el estudio de los movimientos de la corteza terrestre en Colombia mediante técnicas geodésicas espaciales. Le deseamos muchos éxitos en su carrera profesional.

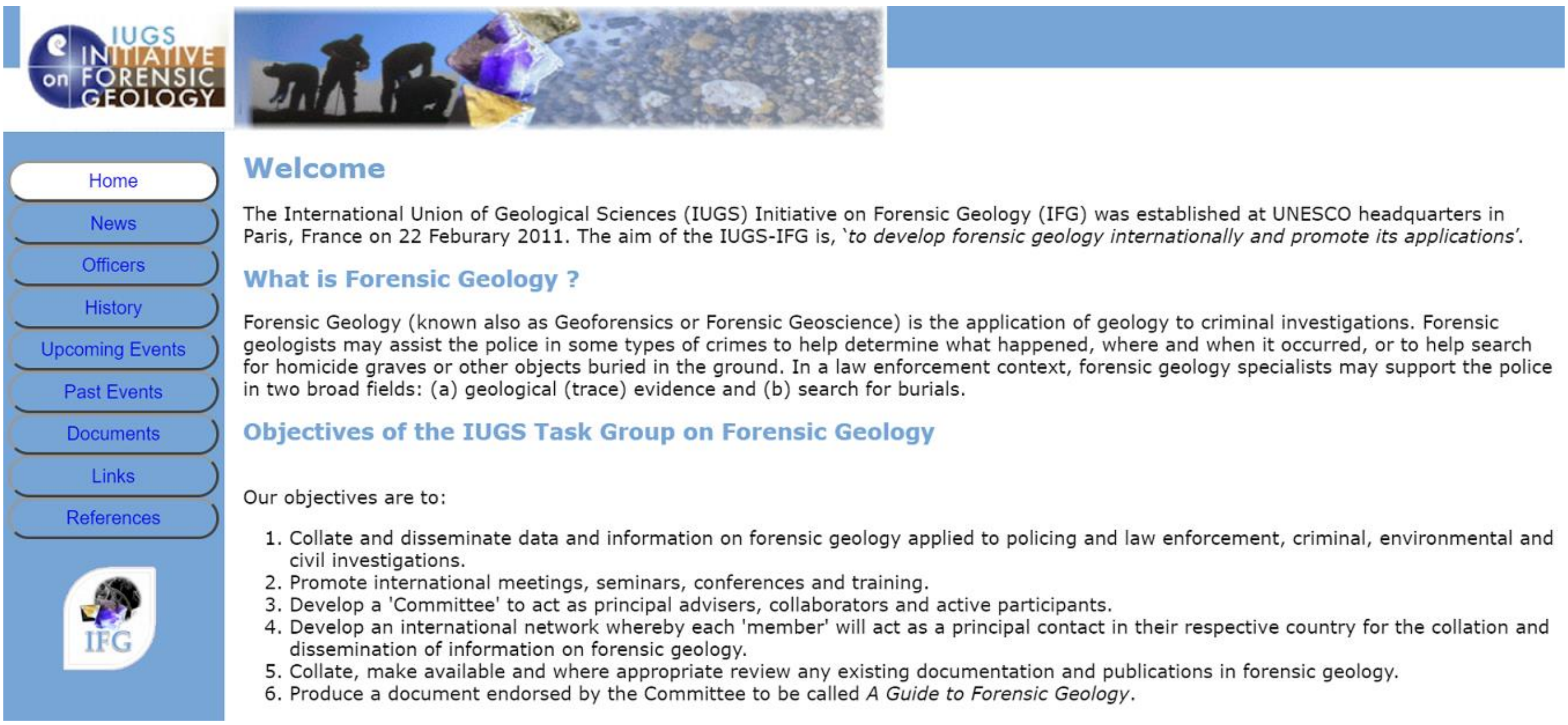
Felicitaciones al Dr. Héctor Mora Páez.

5. 4º Seminario Iberoamericano en Ciencias Forenses

Debido a la falta de espacio en el número anterior no se pudo incluir esta reseña, la cual ahora incorporamos con agrado.

Entre el 27 y 29 de octubre del año anterior se llevó a cabo con gran éxito el 4º Seminario Iberoamericano en Geociencias Forenses en Puerto Vallarta, México, auspiciado por la Unión Internacional de Ciencias Geológicas (IUGS) - Iniciativa en Geología Forense (IFG), en asocio con la Reunión Anual de la Unión Mexicana de Geofísicos, la Universidad Antonio Nariño de Colombia, Policía Federal de Brasil y Ciencias Forenses de Italia. Este evento se enfocó en las aplicaciones geológicas para asistir a la policía y a las agencias gubernamentales con el fin de contribuir con el sistema judicial y coadyuvar con las investigaciones criminales y civiles. Los asistentes al evento fueron académicos, investigadores y especialistas en geología forense, geociencias forenses, arqueología forense, policía y organizaciones gubernamentales.

Cualquier información sobre el evento y las presentaciones pueden encontrarlo en la siguiente página web: http://www.forensicgeologyinternational.org/



6. With gratitude for the life of Doctor Hugo Nicolli - Obituary

United Nations
Educational, Scientific and
Cultural Organization

UNESCO Chair on Groundwater Arsenic within
the 2030 Agenda for Sustainable Development
University of Southern Queensland,
Toowoomba, Australia

We received the sad news to share that our colleague Dr. Hugo Nicolli passed away on 25 April 2020 in Córdoba, Argentina. For almost 40 years he was principal researcher of the Argentine National Scientific and Technical Research Council (CONICET). He was part of the scientific community of the Institute of Geochemistry (INGEOQUI-Air Force, Argentine Ministry of Defense) and the San Miguel Research Center.

Dr. Nicolli was Doctor in Chemical Sciences, and has published more than 140 works in congresses, symposia and high-impact journals, with contributions to national, regional and international scientific events. He was scientific reviewer for publications sent to specialized journals of Germany, Holland and USA. He also participated in the Arsenic group of the Food Security Network (Red de Salud Alimentaria, RSA) of CONICET.

Dr. Nicolli received his degree in geology by the National University of Córdoba (UNC), and later his PhD in Chemical Sciences in the University de Salamanca, Spain (USAL).

Dr. Nicolli was a treasured friend and a highly respected professional in his field. His passion for supporting young researchers is an enduring legacy for which we are extremely grateful. Many of us are blessed to have had the opportunity to work closely with him over years or even decades. He was a warm, wonderful person and we were humbled by his kindness and compassion. He will be thoroughly missed, yet we find some comfort in thinking about all those he inspired to work on water-related, and especially arsenic-related issues, knowing that his work will continue to make the world a better place.

Dr. Nicolli was an internationally recognized researcher and educator, which has been recognized by the global scientific community. He essentially focused on studies on the presence of arsenic in water, mainly in the Chaco-Pampean Plain (Argentina), which covers an area of over one million square kilometers. Here, the concentrations of arsenic and related oligoelements dissolved in groundwater (e.g. F, V, U, Se, Sb, Mo, B) – depending on the local and regional geological, lithological, geochemical and hydrogeological conditions – are highly variable ranging over several orders of magnitude (< 10 up to > 1000 µg/L As; the World Health Organization guideline value is 10 µg/L). These elements principally originate from volcanic activity in the Andes far to the west from where they have been transported by eolic and fluvial processes to the aquifer systems of the Chaco-Pampean Plain. Mobilization of these elements from sediments into groundwater, which is strongly governed by geochemical conditions (in particular pH value and redox potential) result in important potential health impacts for the population as it has been already described over 100 years ago from Bell Ville in Córdoba Province.

During his over 4 decades of research, Dr. Nicolli inspired many national, Latin American and global researchers. Through international collaboration and resulting publications he brought the problem of the groundwater arsenic in Argentina and generally in Latin America to worldwide attention. His work has contributed that the international scientific society and the global society in general understand that the arsenic problem is not only concentrated on Southeast Asia, but that it is of the same order of magnitude in Latin America. Therefore, Dr. Nicolli had a valuable part convincing the global scientific world and world society that arsenic is a global problem. This crucial role of the Latin American continent within the global arsenic problem has been recently proven by the fact that by today (2020) there is proven evidence that the arsenic problems can be found – to very different extent – in all of the 20 Latin American countries.

In 2011, Dr. Nicolli was awarded the MERCOSUR UNESCO Prize in Science and Technology, together with a group of other scientists, in a ceremony which took place in Montevideo (Uruguay), for his participation in a work on arsenic problems in MERCOSUR countries with original contributions and solutions.

In 2014, Dr. Nicolli was nominated as Honorary President of the 5th International Congress “Arsenic in the Environment”, which was held in Buenos Aires, on the occasion of one century of the discovery of the arsenic health effects (HACRE) in Bell Ville, Córdoba. This congress, which was held in May 2014, was declared of Argentine’s national and parliamentary interest and was attended by more than 400 participants from 34 countries coming from five continents, tackling problems and trying solutions for this complex global problem of groundwater arsenic adversely impacting drinking and irrigation water of hundreds of millions of people.

We deeply mourn the death of Dr. Nicolli. We lost a beloved colleague, friend, the kindest and most generous soul and a great personality, who devoted his entire life to the victims of arsenic poisoning. The arsenic community will always remember his contributions in the field of arsenic research and related problems and will miss his supportive, hard-working and optimistic company.

Prof Jochen Bundschuh
Chair Holder

7. Upcoming International Scientific Events

According to the Cities and Volcanoes Commission (CaV) the COV conferences are intended to promote multi-disciplinary approaches to hazards. In submitting the abstracts and associated posters/presentations we invite you to address the relevance of their topic to some aspect of hazards mitigation, as stated by the mission of CaV "*The Cities and Volcanoes Commission aims to provide a linkage between the volcanology community and emergency managers, to serve as a conduit for exchange of ideas and experience between volcano cities, and promote multi-disciplinary applied research, involving the collaboration of physical and social scientists and city officials*.“

For details, please see the conference website:
https://pcoconvin.eventsair.com/volcanoes11/

XXIV Cogreso Geológico de Bolivia “Geociencias para la Sociedad”, del 21 al 23 de octubre de 2020, La Paz, Bolivia, organiza el Colegio de Geólogos de Bolivia.

Más información:
http://www.cgbolivia.org/index.php?option=com_content&view=article&id=122:congresoglg2020#

ICAPAT 2020: 14. International Conference on Archaeoseismology, Paleoseismology and Active Tectonics

December 24-25, 2020 in Vienna, Austria

ICAPAT 2020: 14. International Conference on Archaeoseismology, Paleoseismology and Active Tectonics aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Archaeoseismology, Paleoseismology and Active Tectonics. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Archaeoseismology, Paleoseismology and Active Tectonics.

For details, please see the conference website:
https://waset.org/archaeoseismology-paleoseismology-and-active-tectonics-conference-in-december-2020-in-vienna

Siguiendo con la tradición de los Congresos Geológicos de América Central que se iniciaron en el año 1965, Costa Rica tendrá el honor de reunir por quinta vez a la comunidad geocientífica regional e internacional en el **XIV Congreso Geológico de América Central y VII Congreso Geológico Nacional** a llevarse a cabo el 25, 26, 27 y 28 de Agosto en San José, Costa Rica. El objetivo principal es promover el desarrollo de la geología como ciencia estratégica en la región, para garantizar una mejor calidad de vida a la sociedad a través del aprovechamiento sostenible de los recursos geológicos, asociado a una gestión del riesgo adecuada y un ambiente sano. Más información: http://14cgac.com/

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