

溶岩洞窟の形成プロセスのモデルについて(英文)

-溶岩ブリッジ, 鍾乳石, 溶岩石筈, 溶岩柱, 溶岩球, 溶岩流出物-

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On the Formation Process Model in Lava Cave

-Lava Bridge, Stalactite, Lava Stalagmite, Lava Column, Lava Ball, Lava Driblets-

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ABSTRACT

This study clarifies the local history and is intended to make the document of cultural heritage studies. This report is a part of the general academic investigation of the Cave Environmental Net Society which went On the Formation Process Model in Lava Cave

We have you experience the real thrill of a field science through this cave model, and we wish if that charm is sharable. The formation place of the generation thing in a lava cave can be classified into the ceiling of a cave, the floor of a cave, the surface of a wall of a cave, and a cave pool. It can classify into fall lava, flow lava, collapse lava, volcanic gas, and other lava as environment. A secondary generation thing can be classified into the lava of the flowing lava, the falling lava, collapse lava, and others. The model of a cave was created from these classifications. 13 kinds of formation models about a lava cave were considered.

1. Transition process on lava cave. 2. Mimetic diagram of a lava bridge forming and multi layer cave's process. 3. Forms of lava stalactite. 4. A formation process model about stalactite, lava stalagmite and lava column. 5. Form of lava stalagmite. 6. Mimetic sectional diagram on multi layer and compounded cave. 7. Sectional diagram of connection model of lava cave. 8. Plan view of cave by unification of lava flow. 9. Model of destruction and modification process in lava cave. 10. Destructive process model of the lava bridge in multi layer cave. 11. Lava ball by exfoliation and fall of cave wall. 12. Lava raft by exfoliation and fall of cave wall. 13. Lava driblets of lava overlapped by the fall of twin lava column.

The Lava Bridge, Stalactite, Lava Stalagmite, Lava Column Formation of the model about Lava Ball and Lava Driblets has many unknown points. Therefore, lava formation is scheduled to be established on the basis of this.

[key Words] Model of lava cave, Lava bridge, Lava stalactite, Lava stalagmite, Lava column, Lava ball, Lava driblets

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Acknowledgments, References

1.Introduction

There are those who are considered for a cave to be dark and fearful. The world of dark depths of the earth has the natural mystical beauty and the natural mystical romance which transcend fear. Therefore, neither distribution nor the actual condition is clarified enough yet. However, it is the mystical and attractive existence which is not inferior even if it excels a limestone cave. In Northeast Asia where the Pacific plate and the Eurasia plate collide, volcanic activity is active, and

is the treasury of a global volcano cave, and cave scholars' (Speleologist) hot looks are collected there.

Very various volcanoes are seen in the world. A volcanic zone can be classified into the following four groups. That is, they are Jeju-Do of South Korea where a volcano is seen in Iceland where the volcano, glacier, and lava cave of the Hawaii or a tropical area like Indonesia and the Philippines live together, the Kamchatka Peninsula, and a forest area, lift ballet of Japan and Africa, the volcano of an arid region like Mongolian, etc. A volcanic zone changes with geological environment also in the same volcano. Furthermore, the relation of a volcano and a human life of a volcanic zone is also various.

On the other hand, the cave of ancient since is the place of habitation of man. Some caves are loved by many people in the world as a sightseeing cave or a place (caving) of a sport also the present age. However, a known cave is only one corner of an iceberg. On the earth, many strange caves which do not yet allow man to come near are. We have you experience the real thrill of a field science through this cave model, and we wish if that charm is sharable.

Lava is a general term used for the extrusive rock which melted. A general term is used for the flow on the surface of the earth from a volcanic crater, or its volcanic rock which hardened. A volcano and a lava cave (Volcanic/Lava Cave) can be classified into the volcano cave related term a "volcano", and the lava cave related term "lava."

According to the report of HONG (1981), there is A report of academic investigation about lava cave system of Manjang-cave in Jeju island, and OGAWA (1981) have the report of A report of investigation about lava cave system of Manjang-cave in Jeju island further. Furthermore, according to the report of SAWA et al. (2004), the unique report of pit cave of the cave form and XRF analysis of Gaeng-saengi cave in Sogwipo-shi Jeju-do is performed.

The distribution and origin etc of a cave which form a volcano and a lava cave have the formation (generation) process of a primary lava cave. Since the cave generation thing which forms the inside of a volcano lava cave has an unknown point, it is an important research task. The formation place of speleothem in a lava cave can be classified into circle ceiling (cupola), the cave floor, the cave wall, and a cave pool. The environment of a secondary speleothem can be classified into fall lava, flow lava, collapse lava, volcanic gas, and others.

The circle ceiling(cupola) Model1 is the hollow of the ceiling of a lava tube. As the origin of a circle ceiling, they are the cave made by collapse, and the place which the ceiling by the pressure of gas or lava swelled, and lava overflowed.

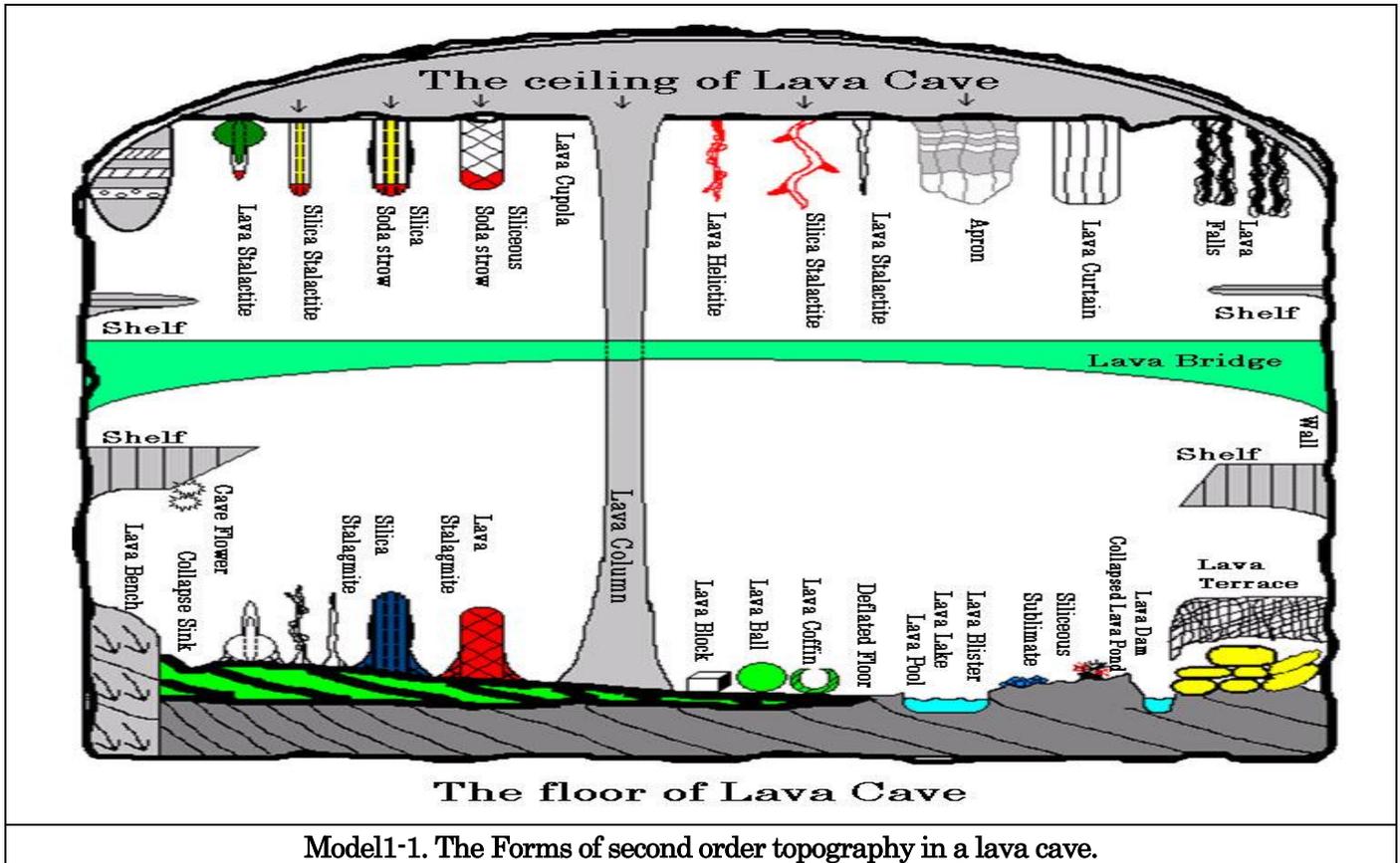
The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006)

A second speleothem is the mineral sediment made into the lava tube. The most abundant sediments in a lava tube are ice. Next, abundant mineral sediments are a silicate, a nitrate, and carbonic acid salt. Furthermore, it is the compound thing of a silicate which comes to the following ranking. Ice, a mineral stone (mineral of water sodium sulfate), and an opal are more abundant in the lava tubes than a limestone cave.

13 kinds of formation models about a lava cave were considered. 1. Transition process on lava cave. 2. Mimetic diagram of a lava bridge forming and multi layer cave's process. 3. Forms of lava stalactite. 4. Growth process model of stalactite, stalagmite and lava pillar. 5. Form of lava stalagmite. 6. Mimetic sectional diagram on multi layer and compounded cave. 7. Sectional diagram of connection model of lava cave. 8. Plan view of cave by unification of lava flow. 9. Model of destruction and modification process in lava cave. 10. Destructive process model of the lava bridge

in multi layer cave. 11. Lava ball by exfoliation and fall of cave wall. 12. Lava raft by exfoliation and fall of cave wall. 13. Dribblets of lava overlapped by the fall of twin lava column.

The model of a cave was created from these classifications (**Model1-1**). This model is a part of only mere volcano lava cave. If the exploration feeling of a cave feels it easy, it is happy. Furthermore, I am pleased if it gets as an opportunity to consider the nature of the precious earth as Gaia through a cave.



2. Forms of Speleothem and its Model

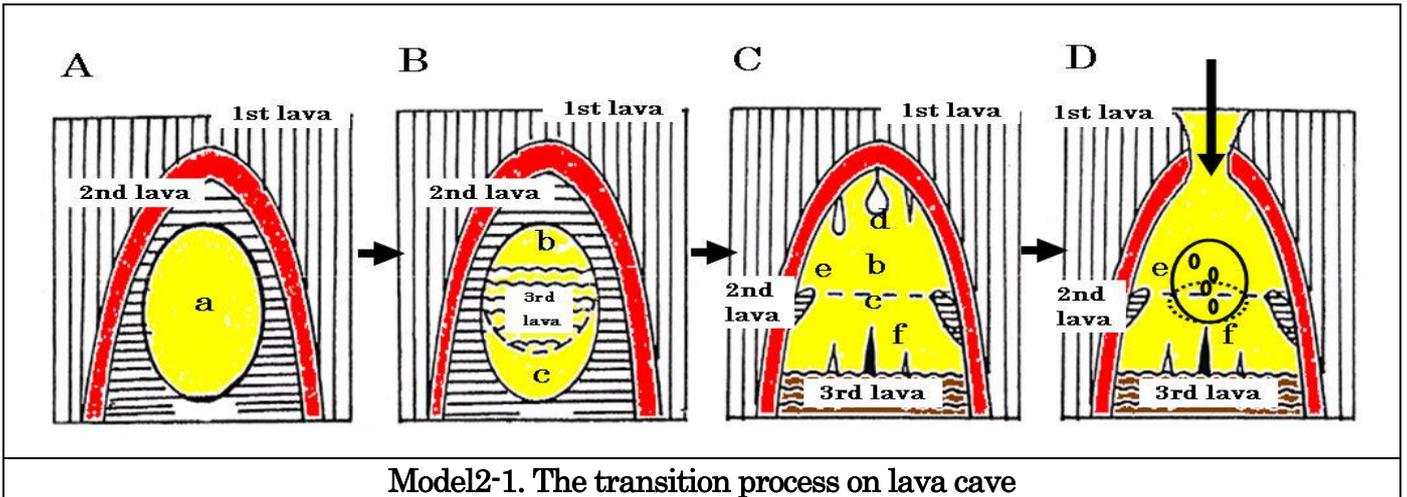
2-1. Transition Process on Lava Cave

溶岩洞窟の遷移過程: The distribution and Origin etc of a cave which form a volcano and a lava cave have the formation (generation) process of a primary lava cave. Since the cave generation thing which forms the inside of a volcano lava cave has an unknown point, it is an important research task. The formation place of speleothem in a lava cave can be classified into circle ceiling (cupola), the cave floor, the cave wall, and a cave pool. The environment of a secondary speleothem can be classified into fall lava, flow lava, collapse lava, volcanic gas, and others.

As a paper about transition process on lava cave, it is as follows. According to SAWA et al. and (2001), it is attached to 「On geologic development and first formation of volcanic caves in Cheju Island and Korea」 SAWA et al. (2005), 「Geomorphological analysis, X-ray analysis and water analysis of Kaeuset-gul cave in Kim-Nyong-Ri, Jeju-Do, and Korea」 and SAWA et al. (2006), there are Nature and cave Kamchatka Peninsula and a Russia-speleological studies on the lava cave in volcano report.

Transition process on lava cave was displayed like **Model2-1**. This lava cave is a process which changes from the left model (Model2. A) to the right model (Model2. D). In **Model 2-1. A**, the vertical bar in the upper levels is a primary lava flow, and the horizontal line in the central part is a

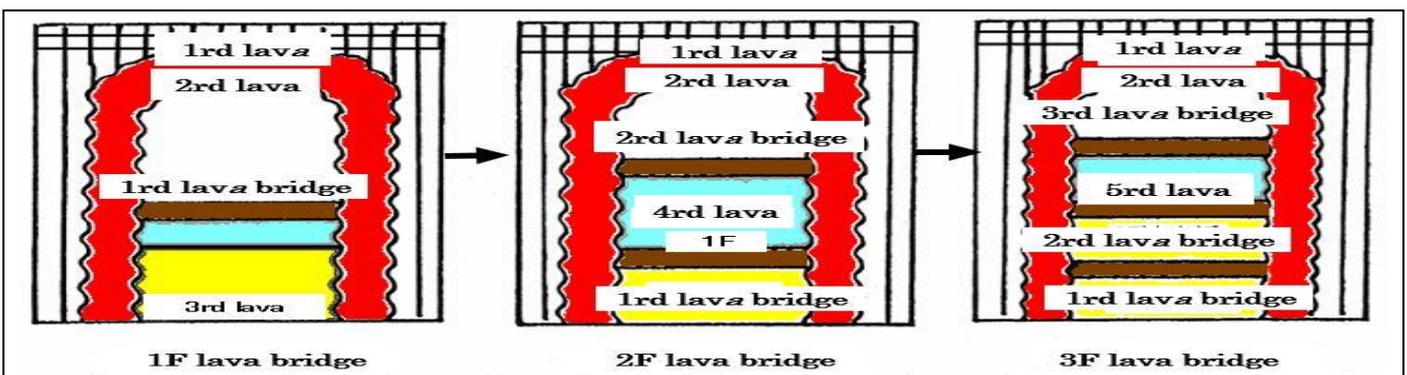
secondary lava flow. A character (a) means a lava cave. **Model 2-1.** B is process in which the 3rd lava flow of a wavy line flows into a lava tube character (a), and the upper part character(b) and the lower part character(c) of a lava flow in the inside of cave a were classified. In Model2.C, near up b of a lava flow, since there is holding time of lava flow, a lava shelf form. A lava icicle forms in the ceiling part of cave a. near c in the lower part of a lava flow, it is in the state which lava stalagmite etc. forms. (stalactite, character(d): lava icicle, character (d and e): lava shelf, and character(f): lava stalagmite) of the 3rd lava flow form the wavy line in a floor part. Model2 D is the cave-in of circle ceiling (cupola), and the sediment of a cave. The changes process of a lava cave is the case of the lava cave of double polygenetic lava cave instead of the lava cave of monogenetic lava cave.



2-2. Mimetic Diagram of Lava Bridge Forming and Multilayer Cave's Process

溶岩橋形成と多層洞化プロセスの模式図: Mimetic diagram of a lava bridge forming and multi layer cave's process was displayed like **Model 2-2.** This enlargement is a secondary lava flow using primary cave. According to SAWA et al. (1999, 2000), there is a report in the title of "X-ray Fluorescent analysis and K-Ar Age determination on lava bridge in Manjang-gul Cave Korea."

The 3rd lava flow is the process passed one after another. The surface part of the lava flow solidified while subsidence of lava floor arose and this process was cooled with the flow to the lower part of lava forms a lava bridge. Net-line in the upper levels of a lava flow is a primary lava flow. The wavy line of the cave surface of a wall is a secondary lava flow. The inside of a slash of a cave is the 3rd lava flow. The surface is cooled, a lower lava flow flows out and lava bridge form (1F) it. The 4th lava is the 4th lava flow, the surface is cooled, a lower lava flow flows out and lava bridge form (2F) it. The 5th lava is the 5th lava flow, the surface is cooled and lava bridge form (3F) is done.



Model 2-2. Forming of a lava bridge the process of multilayer cave's being made

3. Models of Lava Stalactite and its Forms

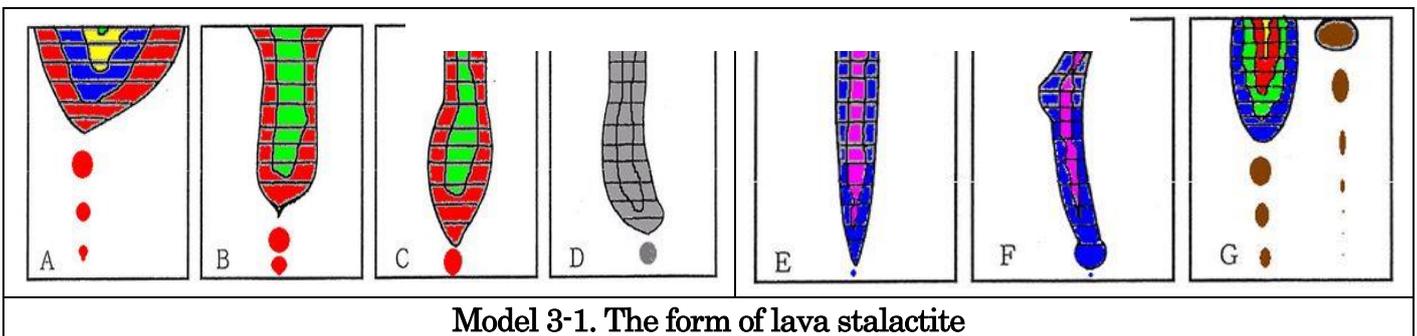
3-1. Forms of Lava Stalactite

Lava helictite is a cylinder type, and is a projection thing whose part is tubular frequently. Usually, although it has become warped and is connected, occasionally it may be straight. It is not based on the influence of gravity. Many are produced together with them like tubular lava helictite. The different point with lava helictite is that lava helictite is not influenced by gravity. Almost all things are sticking out suddenly on the surface of lava, seem to have blown off from the gas pressure on appearance, and can grow at both of the ends. There is a size to that which withered by the branch like a sprig from the small thing with a diameter of 5mm, or the thing of the ordinary size of lava helictite.

According to KASHIMA (2006), the detailed paper is published in the title of "Classification and type of the speleothems." Furthermore, according to the report of "XRF analysis of lava flow and polarizing microscopic study of lava stalactite from Tachibori Fugetsu (cave), Fujinomiya-shi, and Shizuoka" in SAWA et al. (2007), the detailed form is observed.

This comes out even from all kinds of internal side, other helictite, and the broken surface. Forms of lava stalactite of an icicle are lava helictite, lava heligmite, pipe stem stalactite, drip hole, drip line, dripstone, etc. Lava heligmite is irregular helictite and is curved helictite. Pipe stem stalactite is tubular lava stalactite crushed partially, and it has ellipse type like a handle or the crushed section of a tobacco pipe. Drip hole is the hole of the length eroded by waterdrop. Waterdrop makes a waterdrop hole in a sediment and a soluble rock-minerals self-possessed thing. Drip line is a line described in the floor of the opening of a lava tube. Dripstone is a drop stone, and is a cave secondary speleothem which has precipitated from the drop of water. Many forms in lava stalactite are displayed like **Model 3-1**.

Lava stalactite of the figure left becomes various forms with the environmental condition (the lava flow quantity in the cave, the atmosphere of gas, the aggregate, the wind direction of the ingredient) when forming. There is lava with various forms in the ceiling of the right figure. silica soda strow, siliceous soda strow, lava stalactite, silica stalactite, lava fall, ceiling pocket, lava tear, lava helictite, lava blister and lava anthodite as the example, and so on.

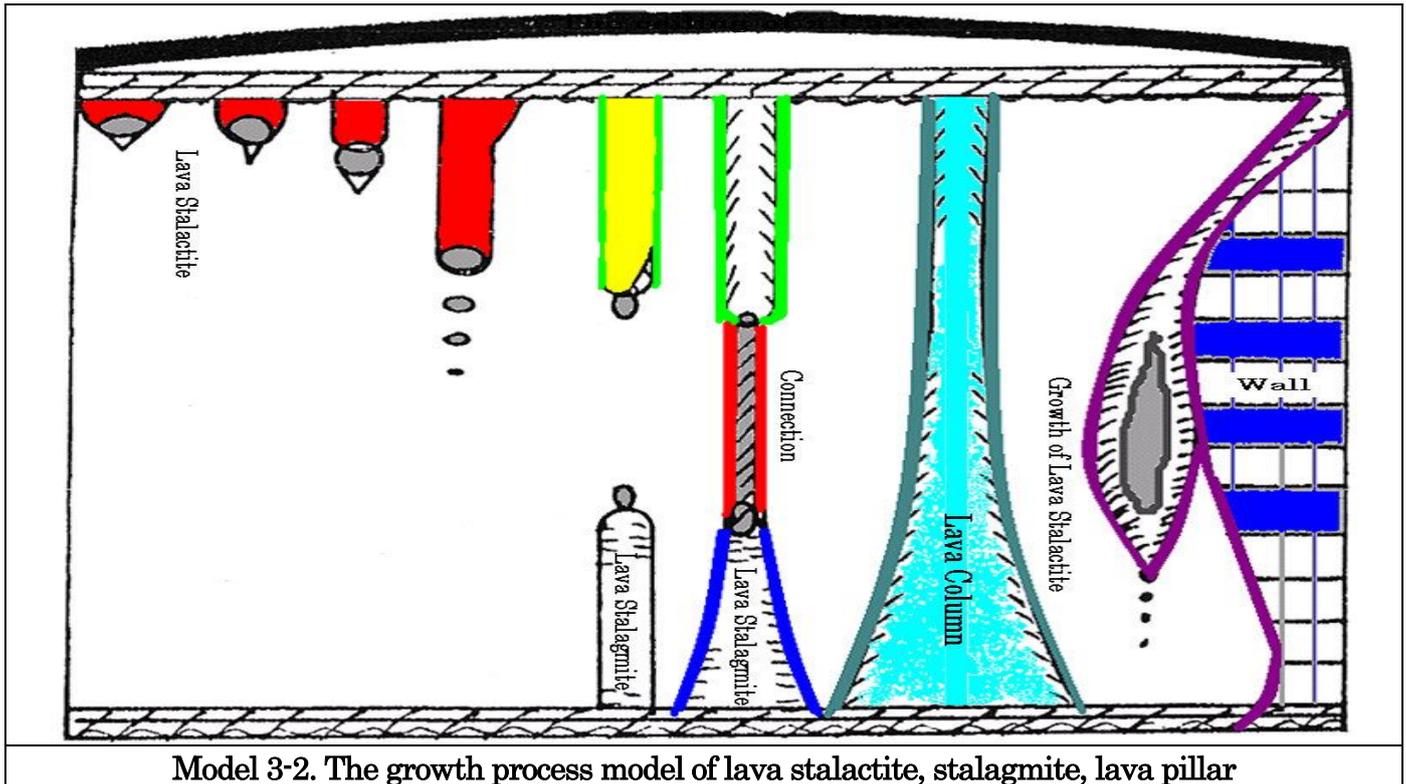


3-2. Growth Process Model of Lava Stalactite, Lava Stalagmite and Lava Column

溶岩つらら石・石筍・溶岩柱の成長過程モデル: Lava stalagmite is called a heligmite, and what bends, grows, goes against gravity by the air current in cave, grows mainly from lava floor, and grows from a ceiling or stalactite calls it helictite. Lava pillar is the lump of the lava which also called it the column and has divided the lava tube over short distance. The diameter of the maximum of a lava pillar is smaller than the width

which two passages united. In other words, stalagmite docks with stalactite and it becomes pillar-shaped. On the other hand, it is a cave secondary speleothem called the cave generation thing of the lava connected from the floor to the ceiling. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006)

The growth process model of lava stalactite, lava stalagmite and lava pillar was displayed like **Model 3-2**. Lava stalactite grows in turn from the left of the figure to the right. This connects and a lava pillar is formed. The right end of the figure is the transformation type which was grown along the wall. There is another generating process in the thing except this, too.



Model 3-2. The growth process model of lava stalactite, stalagmite, lava pillar

3-3. Forms of Lava Stalagmite

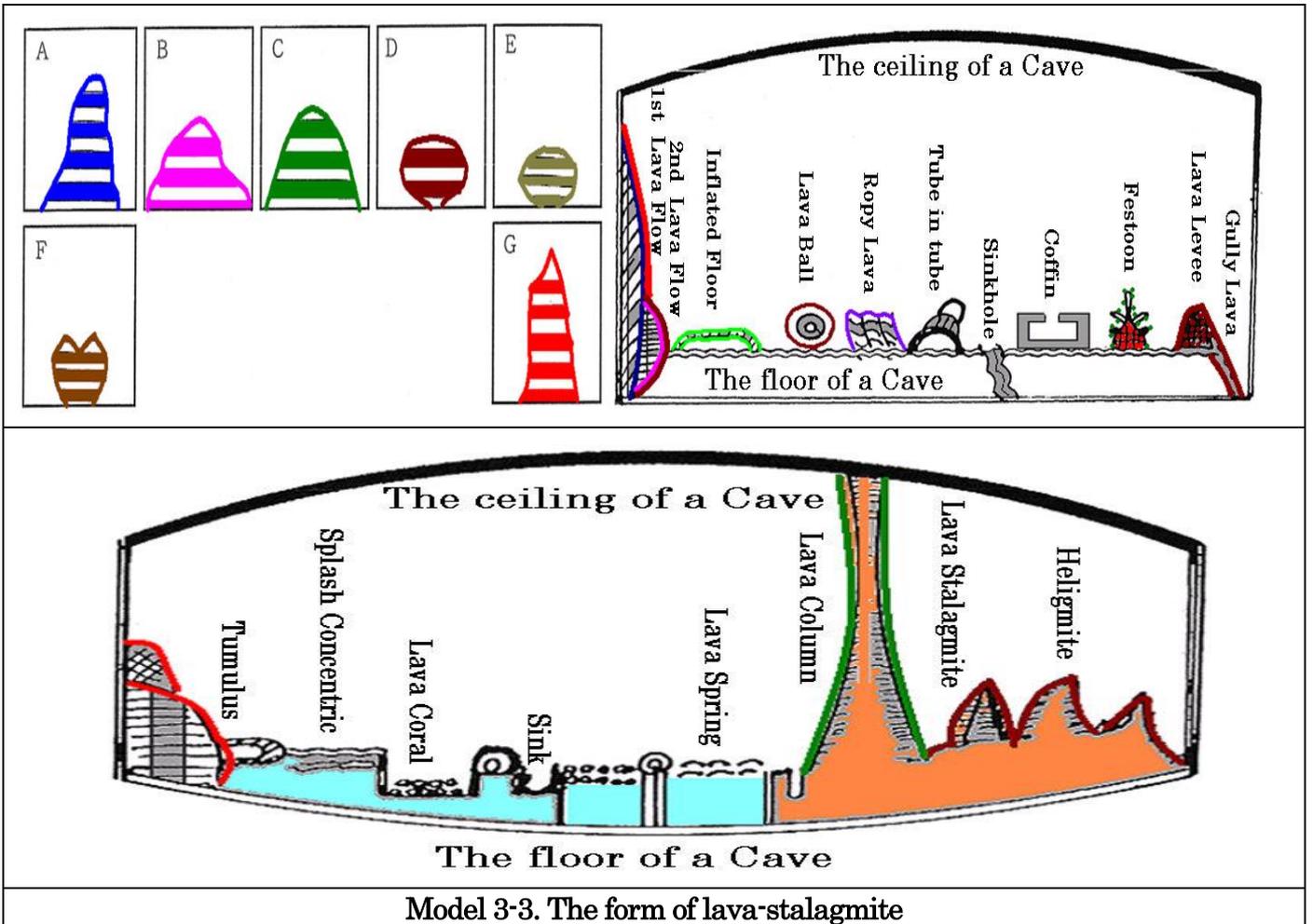
溶岩石筈の形態: Stalagmite is the cave of the calcite extended from lava floor. In other words, it sinks from the groundwater which falls from a ceiling, and they are the floor of a lava tube, or the sediment of shelving. Stalagmite is not necessarily a cave secondary speleothem. In the limestone cave, stalagmite is corresponding stalactite and a corresponding pair. Lava stalagmite is the upward accumulation thing made from the half-solidification or the solidified lava drop which dripped.

According to OKADA et al., (1991), as for the age determination about stalagmite, the report of "K-Ar determination of a lava stalagmite in Manjang-gul and Jeju island Korea" is performed. Furthermore, there is a report in the title of "Qualitative analysis of rock sample form the lava stalagmite in Manjang-gul cave by X-ray diffraction method" (SAWA, 1991).

It has the thing of various forms or a size, and the width which stands barely on the floor is wide, is low, and there is to the huge thing which exceeds 2m from a lava rose. The lava stalagmite which exists first was attached to the ceiling or the wall, and is a low projection portion, lava stalactite, etc. The surface of the fall place is moved and it stops usually suiting stalactite and stalagmite on a number. The form of lava stalagmite is displayed like **Model 3-3**.

The development process (left figure) of lava stalagmite is a general expression of the process which grows

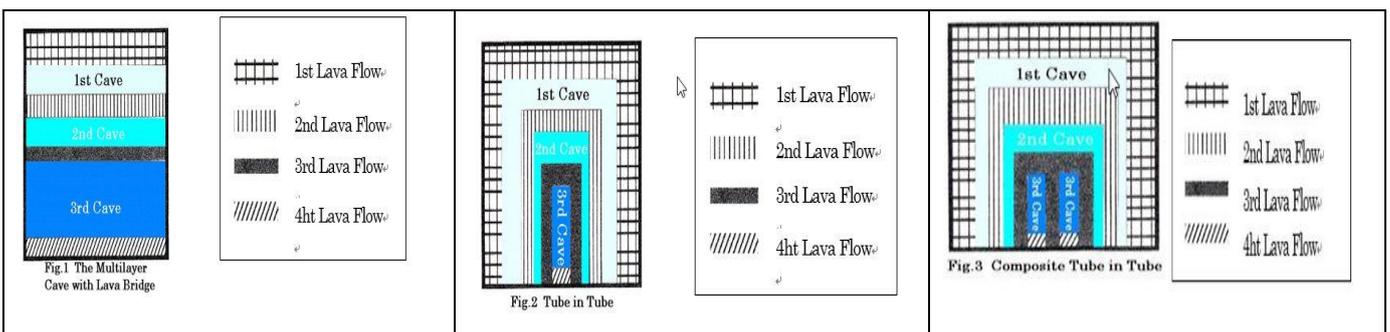
upwards with the lava icicle which falls from the ceiling part of a cave. The secondary generation thing (an upper right figure and the following figure) seen to the lava cave floor is a process which grows upwards with the lava icicle. On the other hand, the secondary generation thing shows what changed by the gas of a floor, or sedimentation.



4 .Many Forms in Lava Compounded Cave and its Model

4-1. Mimetic Sectional Diagram on Multilayer and Compounded Cave

多層洞と複合洞の模式断面図:A multilevel tube is a lava tube which divided into two or the level beyond it. Each is long and slender and is divided by the lower level roof. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006)



Model 4-1. The section on the multilayer cave, the compounded cave

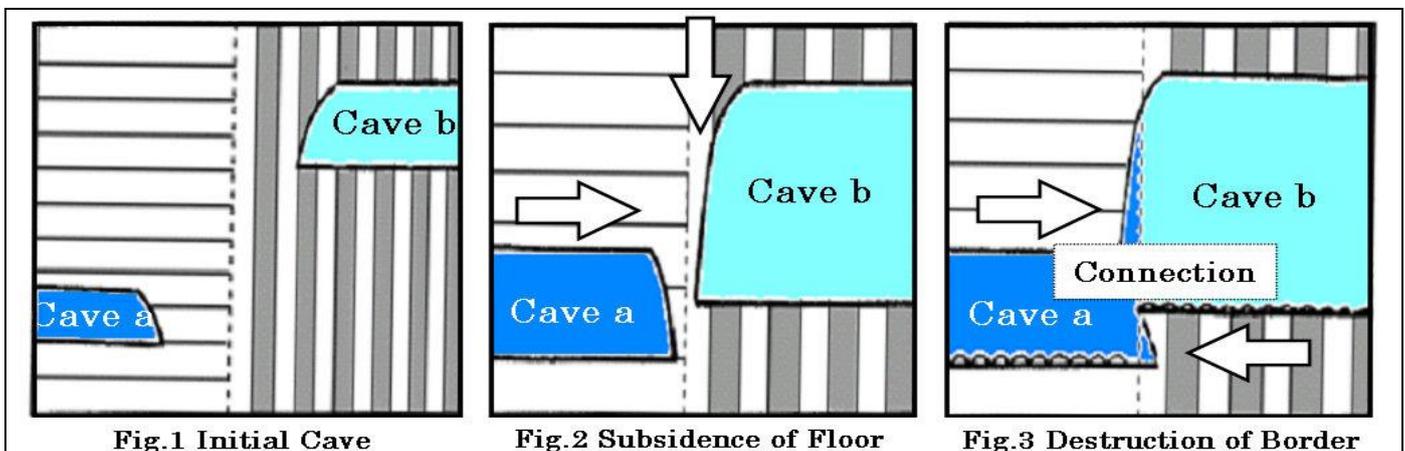
Mimetic sectional diagram on multilayer and compounded cave is displayed like (Model 4-1). This sectional view is multi layer cave accompanied by a lava bridge. Into an old lava tube, afterwards, when the 4th lava flow flows in one after another from the 2nd order, Tube in tube is formed. Tube in tube is that the lava flow flowed below in the portion of the passage belt of a lava flow, and it is a premise that subsidence of a floor takes place.

Model 4-1(Fig.1) is multilayer cave accompanying a lava bridge. That is, the straight line of the shape of a net in the upper part of primary lava is the ceiling part of a primary lava flow, and is also the space of a secondary lava flow. The solid line in the central part of secondary lava caves is the ceiling part of the 3rd lava flow, and is the space of the 3rd lava flow which exists in the middle of a primary cave and the 3rd cave. The straight line in the lower part of a 3rd lava cave is the ceiling part of the 4th lava flow, and is the space of the 4th lava flow. **Model 4 -1 (Fig.2)** is Tube in tube. That is, a primary lava flow forms a ceiling and a wall and serves as a primary cave. The secondary lava flow which flowed into the primary cave forms a ceiling and a wall, and makes a secondary cave. The 3rd lava flow repeats the same process and makes the 3rd cave. Finally, the 4th lava flow flows in and it is set to Lava floor. **Model 4-1 (Fig.3)** is Composite Tube in tube. That is, the straight line of the shape of a net in the upper part of a primary cave is the ceiling part of a primary lava flow, and is space of the primary secondary lava flow which consists of a solid line. The glasses form in the central part of secondary lava caves is the ceiling part of the 3rd lava flow, and is the space of the 3rd lava flow.

4-2. Sectional Diagram of Connection Model of Lava Cave

溶岩洞窟の連結モデルの断面図: Kipuka says the left old hill which was surrounded by new lava. It is called landslide cave which is the cave which the sediment of a hillside started the landslide and produced. When such, it is thought that many caves are connected by the lava flow. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006)

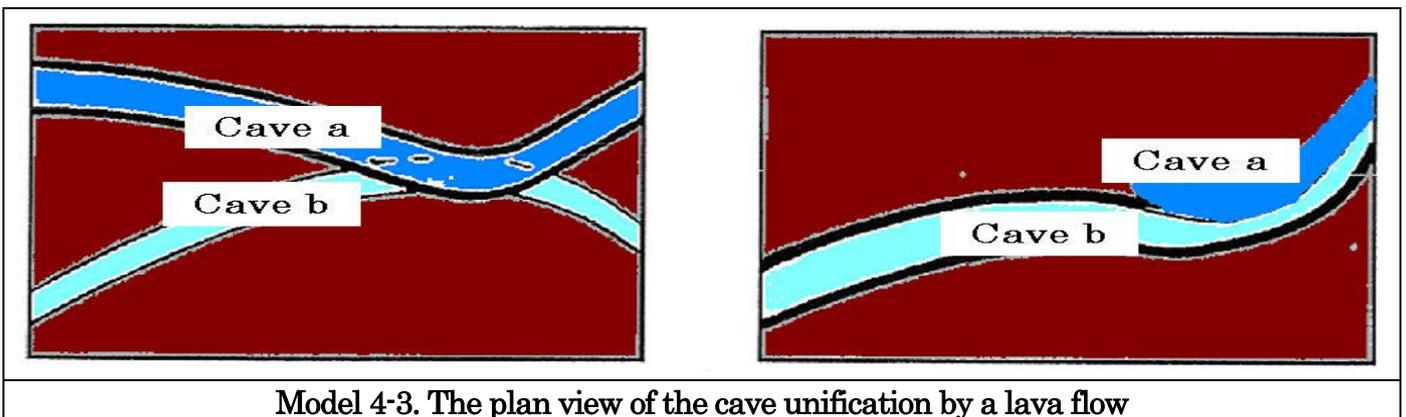
Sectional diagram of connection model of lava cave is displayed like **Model 4-2(Fig.1)**, the lava flow in which the initial cave 1 and the initial cave 2 were formed shows right and left. A horizontal line is the lava flow of the lava cave 1. A vertical bar is the lava flow of the lava cave 2. In **Model 4-2(Fig.2)**, by sinking like a flow of the lava flow in which the cave 1 and the cave 2 were formed, and an arrow, the lava cave 1 and the lava cave 2 increase, and it approaches. In **Model 4-2(Fig.2) Fig. 3**, it is the form which a cave 1 and a cave 2 connect by destruction of a boundary part.



Model 4-2. The section which the lava cave connected

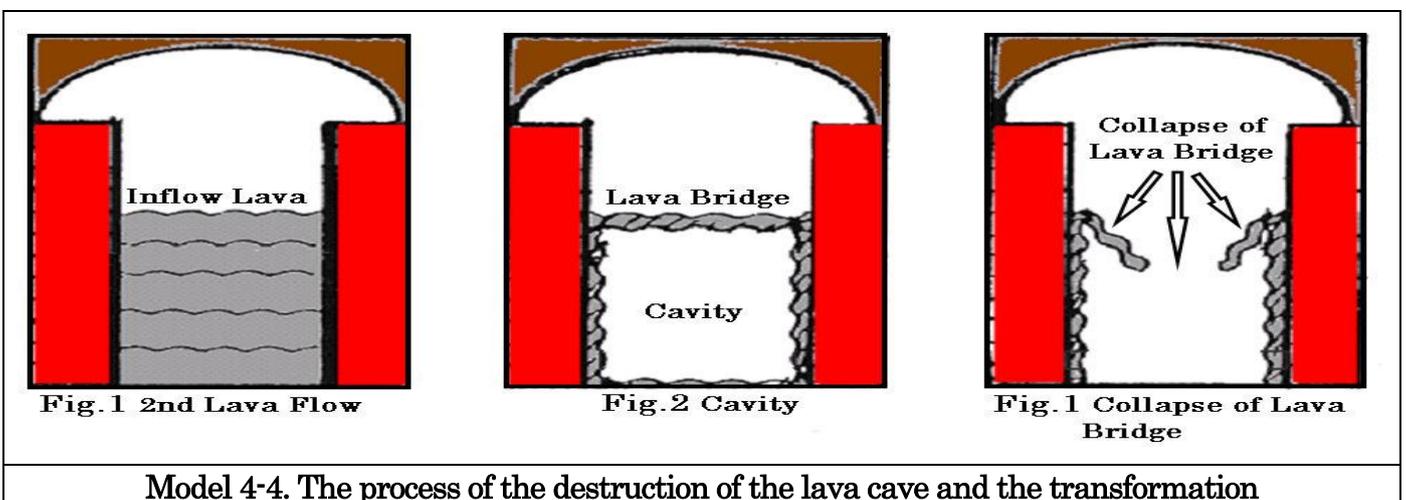
4-3. Plan View of Cave by Unification of Lava Flow

溶岩流による洞窟合流の平面図: The lava tube made in the inside of the lava flow which flowed into the crack is called rift tube. It is the lava tube which it flows out, and Resurgence cave also calls Effluent Tube, and separates from main cave and through which it is flowing, and groundwater is the cave which serves as a river and is flowing out. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science. The plan view of cave by unification of lava flow was displayed like **Model 4-3** and the lava cave of a thin line is set to (b). The left figure is the case in which lava flow of (a) and lava flow of (b) crossed. In right figure, it is the case with which two lava flows overlapped. That is, two caves formed by overlap are cases which joined and became one cave.



4-4. Model of Destruction and Modification Process in Lava Cave

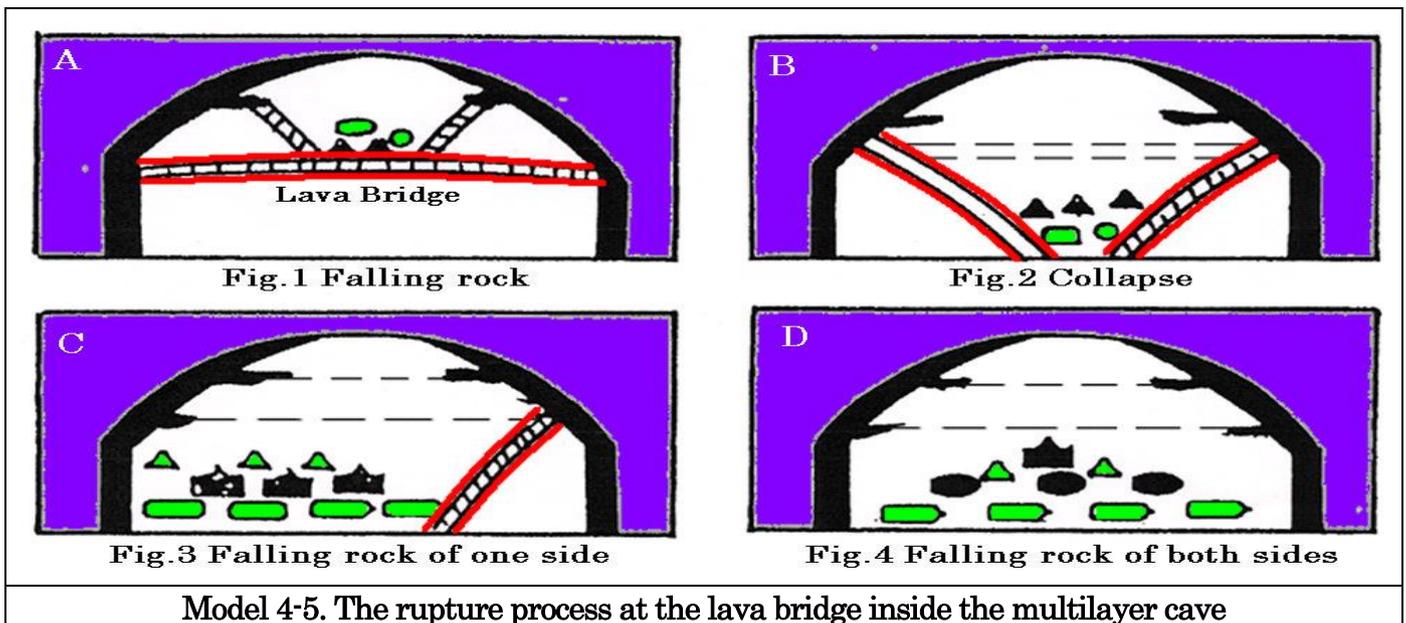
溶岩洞窟の破壊・変形過程モデル: Model of destruction and modification process in lava cave was displayed like **Model 4-4**. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006) A secondary lava flow flows out of an initial cave (primary cave), and, subsequently, as for destruction of a cave, and the process of modification, a multilayer cave is formed with an outflow. Then, the cave of a lower layer part performs process of a cave-in, deposition, and disappearance by advance of collapse of the lava bridge in a cave and a cave wall.



4-5. Destructive process model of the lava bridge in multilayer cave

多層洞中の溶岩橋の破壊過程モデル: Destructive process model of the lava bridge in multi layer cave was displayed like **Model 4-5**. The destructive process of a lava bridge is a process which changes from an early stage (A) to a collapse stage (B), a crash stage (C), and the final stage (cave-in of a ceiling) (D) in Tube in tube. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006)

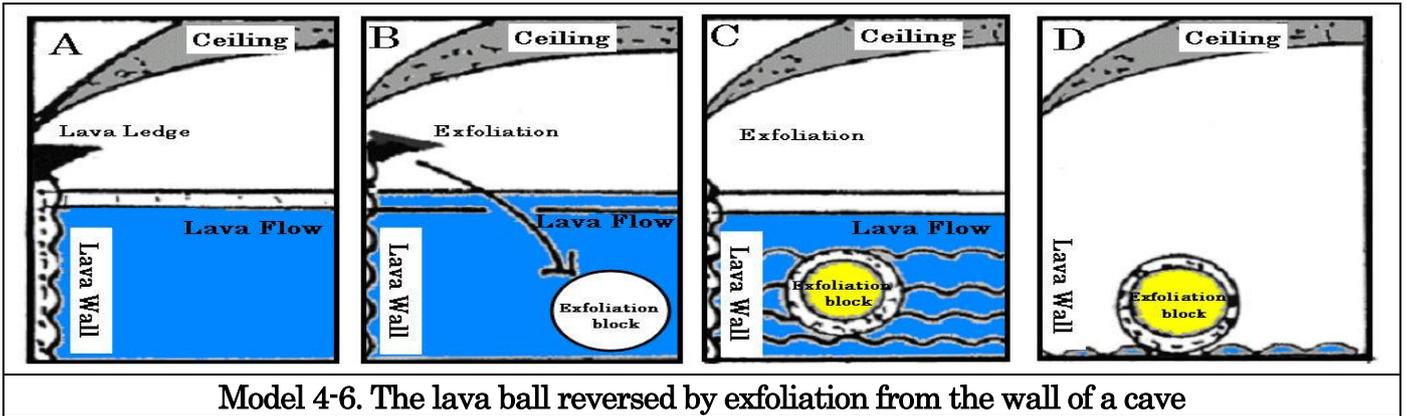
In **Fig. 1**, the lava bridge of letter of an inclination on a lava bridge is collapse of an old lava bridge. In **Fig. 2**, the lava bridge of letter of an inclination is a collapse stage by a fracture and fall of the central part of the lava bridge. In **Fig. 3**, since left-hand side is the stage which collapse finished, the lava bridge has been lost. In **Fig. 4**, it is at the stage where the lava bridge of both sides has stopped having collapsed. The cause of disappearance process, collapse, and a cave-in of a lava cave is degradation by weathering. In addition, it is rapid increase of the pore pressure accompanying an earthquake motion and a heavy rain etc.



4-6. Lava Ball by Exfoliation and Peeling of Cave Wall

洞壁の剥離(脱)、転倒と関係した溶岩球: Lava ball is also called a cape ball, and the rock which flowed into pot hole in a cave flows out, and is rotated and worn out, and a lava ball becomes spherical. Lava ball by exfoliation and fall of cave wall was displayed like **Model 4-6**. Formation of a lava ball is a process which the stage (B) which a lava shelf collapses from an early stage (A) in Tube in tube, and falls in a lava flow, the stage (C) which a lava shelf collapses, falls and forms subsidence lava husks in a lava flow, and a lava flow, and changes to the final stage (D). The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006)

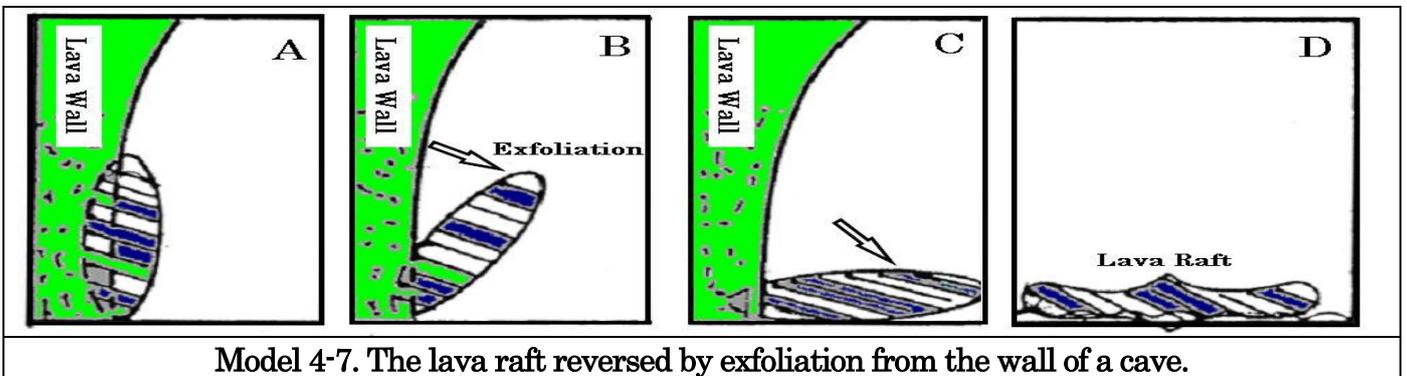
Process in which a lava cave disappears, the collapsing process, and the cause of a cave-in have degradation by weathering. In addition, there is rapid increase of the pore pressure accompanying an earthquake motion and a heavy rain etc.



4-7 Lava Raft by Exfoliation and Peeling of Cave Wall

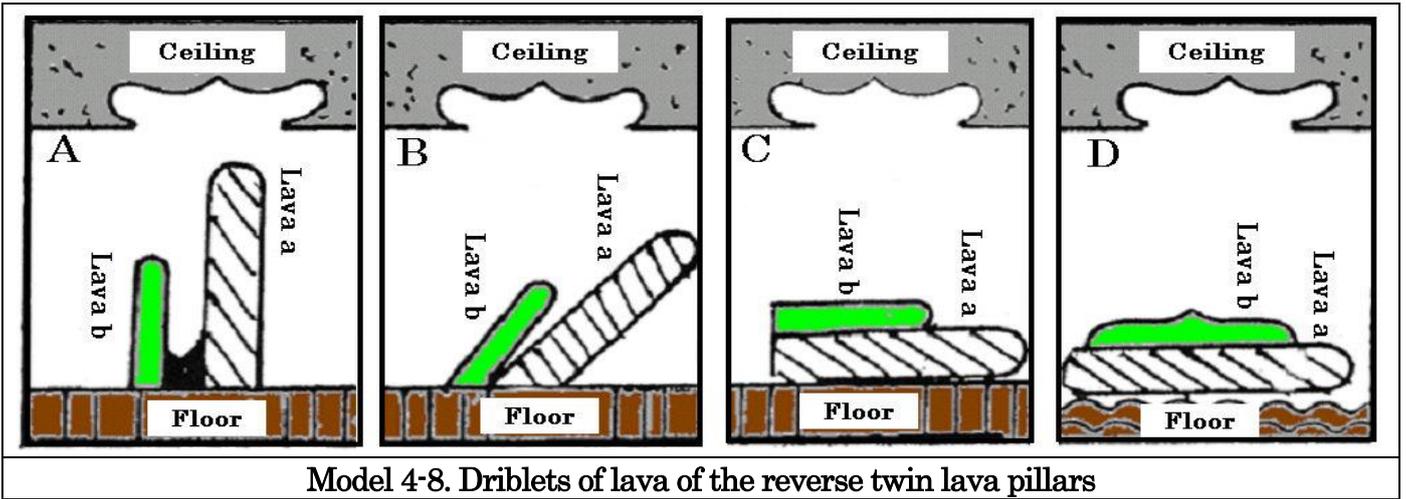
洞壁の剥離(脱)、転倒と関係した溶岩筏; That (usually fragment of a collapse thing) in which one or the solidified lava accumulated floats on a lava flow, or rafted breakdown is carried. Although solid basalt is slightly heavier than basalt of a liquid, since the solidified lava contains air bubbles, many collapse things have floated. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006)

Lava raft by exfoliation and fall of cave wall was displayed like **Model 4-7**. Formation of lava raft is a process which changes from the stage (Fig.B) where a lava wall is isolated from an early stage (Fig.A) in multi layer cave, and a stage (Fig.B) to the final stage (Fig.D) by which it was washed away along with the lava flow in the stage (Fig. C) and stage (Fig.C) which caved in to the floor. On the other hand, there are a piece of lava, a lava lump, etc. which blew off from the crater. A cave-in and falling stone of a cave ceiling, secession from the surface of a wall, etc. serve as a core, and are formed into the lava flow in a cave.



4-8. Cumulative Type of Lava Dribbles based on the fall of Twin Lava Column

溶岩柱中の転倒に基づく累重型の溶岩餅:Lava Dribbles overlapped by the fall of twin lava pillars was displayed like **Model 4-8**. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006) Lava pillar is a process which overlaps with a floor through the piece of lava of an early stage (A), and the stage which (B) reverses in multi layer cave and by which it is further washed away along with a lava flow. The process is also the lump of the piece of lava resulting from the cave-in of a ceiling. Lava pillar changes by the lava bridge, a lava pillar, crash of a ceiling, etc. The cooling block involved in the surface of secondary lava flow on which the modification process flows the inside of a cave flows together as lava raft.



Model 4-8. Driblets of lava of the reverse twin lava pillars

5. SUMMARY

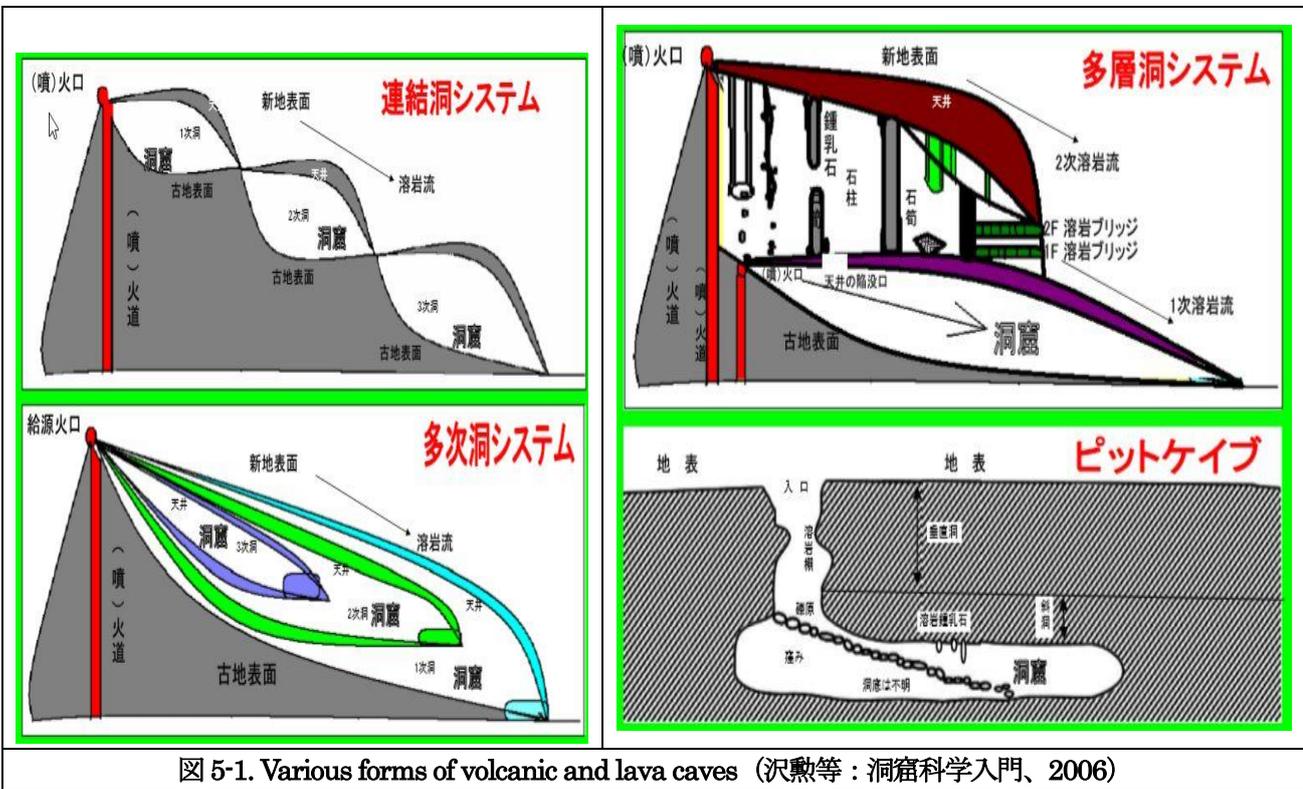


図 5-1. Various forms of volcanic and lava caves (沢敷等：洞窟科学入門、2006)

A **pit cave, shaft cave or vertical cave**—or often simply called a **pit** (in the US) or **pot** (in the UK)—is a type of natural cave which contains one or more significant vertical shafts rather than being predominantly a conventional horizontal cave passage. Pit caves typically form in limestone as a result of long-term erosion by water. They can be open to the surface or found deep within horizontal caves. Among caves, a pit is a vertical drop of any depth that cannot be negotiated safely without the use of ropes or ladders.

Lava channel is also called channel. A channel is the slot of the long open type of a lava flow top and inside, and is filled by lava, or is filled before. Or lava channel is bordered with a wall, and is higher than the circumference in many cases. The Lava channel inside a lava tube is general quite small, meets in the center of a cave and is made. A rare form has the chrysanthemum shape, a crystal, and the flow stone. Furthermore, some second speleothem has lava bridge, lava stalactite,

lava stalagmite, lava pillar : column, lava ball, lava raft, etc. The books edited as the photograph about a cave, a glossary, and term description are "Technical terminology of caves multilingual translation" and "The pictorial guide to cave science." (SAWA et al., 2004, 2006)

Flow Feature is the general term of the geographical feature made by motion of the melted lava. Flow Feature shows the form and the rock surface which were formed in rheology, it is fixed when lava gets cold. It is the projection part or slot in a wall or a floor, and flow line is not large as it affects the cross-sectional type of a cave. Typically, discontinuation of a fall of a lava flow side describes the streamline in alignment with a wall, and it becomes stairs-like frequently. Generally, the streamline inclines the inside of cave gently reflecting the level of the hydrostatic pressure of a lava flow.

Table5-1. Relationship between SiO₂ and patchy tissue (沢敷等:洞窟科学入門、2006)

SiO ₂ の含有量	～45wt.%	45～52wt.%	52～66wt.%	66wt.%～
性質		苦鉄質・塩基性	中性・中性岩	珩長質・酸性岩
色彩		濃い色	中間色	淡い色
深成岩	かんらん岩	斑れい岩	閃緑岩	花崗岩
半深成岩		粗粒玄武岩・輝緑石	玢(ひん)岩	石英斑岩
火山岩		玄武岩(Basalt)	安山岩(Andesite)	流紋岩(Rhyolite)
SiO ₂ の量		少量	中間量	多量
粘性		低い粘性	中間粘性	高い粘性
温度(°C)		高い温度 (1200°C)	中間温度 (1000°C～1200°C)	低い温度 (800°C～1000°C)
噴火の激しさ		極小噴火・穏やか	小噴火(ストロンボリ式)	大噴火(ブルカノ式)
火山の型		盾状火山	成層火山	溶岩円頂丘
噴火の形				

表 5-2. Location and environment of secondary products in lava caves (沢勲等：洞窟科学入門)

形成場所 環境	洞窟の天井	洞窟の床面	洞窟の壁面	洞窟湖 (プール)内					
落下溶岩 世	溶岩キューポラ (Lava Cupola)	縄状溶岩 (Ropy Lava)	溶岩棚 (Lava Shelf)	陥没溶岩池 (Collapsed Lava Pond)	流動溶岩	挟石 チョックストーン (Chock Stone)	溜れ滝 (Dry Fall)	洞窟豆石 (Cave Pisolite)	
	シリカつらら石 (Silica Stalactite)	溶岩柱 (Pillar)	エプロン (Apron)	溶岩泡 (Lava Blister)		溶岩堤防 (Levee)	凹地床 (Hollow Floor)		
	溶岩カーテン (Lava Curtain)	崩壊窪地 (Collapse Sink)	溶岩ベンチ (Lava Bench)	溶岩湖 (Lava Lake)	崩壊溶岩	陥没 コラプス (Collapse)	陥没凹地 (Collapse Sink)	陥没溶岩池 (Collapsed Lava Pond)	
		溶岩棺桶 (Lava Coffin)		洞窟真珠 (Cave Pearl)		火山ガス	火山ガス (Volcanic Gas)	火山湖 (Volcanic Lake)	
		沈降床面 (Deflated Floor)	肋骨状溶岩 (Ribbed Lava)		その他の溶岩	溶岩ヘリクタイト (Lava Helictite)	溶岩ヘリグマイト (Lava Heligmite)	溶岩ヘリクタイト (Lava Helictite)	ケイ酸華 (Siliceous Sublimate)
		溶岩滝 (Lava Falls)	溶岩滝 (Lava Falls)			洞窟サンゴ (Cave Coralloid)	溶岩さざ波 (Splash Concentric)	洞窟石花 (Cave Flower)	珪酸質華 (Siliceous Sinter)

Lava helictite is a cylindrical shape and is a protrusion whose part is often tubular. But sometimes it is straight. It is not due to the influence of gravity. A lot of lava helictite. It resembles a tubular lava stone milk, which is accompanied by them. Heligmite is also called curved stone, growing bending against gravity, growing mainly from the sinus, called heligmite growing from the ceiling and the stalactite. Bent stone (helictite・heligmite) is one of the strangest and interesting stalactites. From the surface of the sinus floor, cave wall and other stalactites to meander and grow in all directions independently of gravity. It is said that the cause grows with a kind of capillary phenomenon, but it is not certain. What stretches from above is called a helictite. Lava lake is a lava stagnant due to the flowability of basalt in the volcanic crater or depression. Lava Lake is not only fluid lava but also solidified or partially solidified state.

The formation model about a lava cave was summarized as follows.

5-1. Transition process on Lava Cave

The distribution and Origin etc of a cave which form a volcano and a lava cave have the formation (generation) process of a primary lava cave. The formation place of speleothem in a lava cave can be classified into circle ceiling (cupola), the cave floor, the cave wall, and a cave pool. The environment of a secondary speleothem can be classified into fall lava, flow lava, collapse lava, volcanic gas, and others.

Alava flow, since there is holding time of lava flow, a lava shelf forms. A lava icicle forms in the ceiling part of cave a. near c in the lower part of a lava flow, it is in the state which lava stalagmite etc. forms. (stalactite, character(d): lava icicle, character(d and e): lava shelf, and character(f): lava stalagmite) of the 3rd lava flow form the wavy line in a floor part. The changes process of a lava cave is the case of the lava cave of double polygenetic lava cave instead of the lava cave of monogenetic lava cave.

5-2. Lava Bridge

Mimetic diagram of a lava bridge forming and multi layer cave's process was displayed like Model3. This enlargement is a secondary lava flow using primary cave. The surface part of the lava

flow solidified while subsidence of lava floor arose and this process was cooled with the flow to the lower part of lava forms a lava bridge. Net-line in the upper levels of a lava flow is a primary lava flow. The wavy line of the cave surface of a wall is a secondary lava flow. The inside of a slash of a cave is the 3rd lava flow. The surface is cooled, a lower lava flow flows out and lava bridge form (1F) it. The 4th lava is the 4th lava flow, the surface is cooled, a lower lava flow flows out and lava bridge form (2F) it. The 5th lava is the 5th lava flow, the surface is cooled and lava bridge form (3F) is done.

5-3. Lava Stalactite

Lava helictite is a cylinder type, and is a projection thing whose part is tubular frequently. Usually, although it has become warped and is connected, occasionally it may be straight. It is not based on the influence of gravity. Many are produced together with them like tubular lava helictite. The different point with lava helictite is that lava helictite is not influenced by gravity. Almost all things are sticking out suddenly on the surface of lava, seem to have blown off from the gas pressure on appearance, and can grow at both of the ends.

5-4. Lava Stalagmite

Lava stalagmite is called a heligmite, and what bends, grows, goes against gravity by the air current in cave, grows mainly from lava floor, and grows from a ceiling or stalactite calls it helictite. Lava stalagmite is the upward accumulation thing made from the half-solidification or the solidified lava drop which dripped. The lava stalagmite which exists first was attached to the ceiling or the wall, and is a low projection portion, lava stalactite, etc. The surface of the fall place is moved and it stops usually suiting stalactite and stalagmite on a number.

5-5. Lava Column

Lava column is the lump of the lava which also called it the column and has divided the lava tube over short distance. The diameter of the maximum of a lava pillar is smaller than the width which two passages united. In other words, stalagmite docks with stalactite and it becomes pillar-shaped. On the other hand, it is a cave secondary speleothem called the cave generation thing of the lava connected from the floor to the ceiling.

5-6. Lava Ball

Lava ball is also called a cape ball, and the rock which flowed into pot hole in a cave flows out, and is rotated and worn out, and a lava ball becomes spherical. Lava ball by exfoliation and fall of cave wall was displayed like Model12. Formation of a lava ball is a process which the stage (B) which a lava shelf collapses from an early stage (A) in Tube in tube, and falls in a lava flow, the stage (C) which a lava shelf collapses, falls and forms subsidence lava husks in a lava flow, and a lava flow, and changes to the final stage (D). Process in which a lava cave disappears, the collapsing process, and the cause of a cave-in have degradation by weathering.

7-7. Lava Dribblets

Lava Dribblets overlapped by the fall of twin lava pillars was displayed like Model14. Lava pillar is a process which overlaps with a floor through the piece of lava of an early stage (A), and the stage which (B) reverses in multi layer cave and by which it is further washed away along with a lava flow. Lava pillar changes by the lava bridge, a lava pillar, crash of a ceiling, etc. The cooling block involved in the surface of secondary lava flow on which the modification process flows the inside of a cave flows together as lava raft.

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