GEOLOGY CULTURE

Geomythology and Tectonic Evolution: A Technical Analysis of North Sumatran Lacustrine Formations

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The intersection of oral tradition and geological science offers a profound lens through which we can understand the landscape evolution of the Indonesian archipelago. North Sumatra, situated atop the highly active **Sumatran Fault System (SFS)**, serves as a primary laboratory for studying how cataclysmic earth movements are codified into cultural narratives. Among the most compelling examples are the legends of **Tao Silosung** and **Tao Sipinggan**, which, when analyzed alongside the well-documented formation of **Lake Toba** and **Lake Singkarak**, provide a comprehensive framework for understanding regional geomorphology. This analysis explores the technical mechanics of lake formation, the literary reception of folk legends, and the structural geology of the Tapanuli region.

1. The Geomythological Framework of Tao Silosung and Tao Sipinggan

In the discipline of **geomythology**, researchers investigate how ancient oral traditions may store memories of real geological events, such as volcanic eruptions, earthquakes, or tsunamis. The legend of **Danau Si Losung** and **Danau Si Pinggan**, located in the Silahan region of North Sumatra, provides a classic case of anthropomorphic displacement of geological energy.

The Narrative Structure and Characters

The legend centers on two brothers, **Datu Dalu** and **Sangmaima**. Datu Dalu, the elder, is characterized by his expertise in traditional medicine and martial prowess, while Sangmaima represents the challenging younger sibling. The technical core of the legend involves a violent physical altercation. According to the oral tradition, the conflict escalated to the point where household implements—specifically a **Losung** (a heavy stone mortar used for pounding rice) and a **Pinggan**(a large ceramic plate)—were hurled with such force that they created deep depressions in the earth, which subsequently filled with water to become the two lakes.

Symbolism and Physical Correspondences

From a technical writer's perspective, the use of the **Losung** and **Pinggan** as metaphors is significant. The **Losung** typically creates a deep, narrow basin, while the **Pinggan**creates a wider, shallower depression. This mirrors the actual bathymetry of many small tectonic or volcanic lakes in the Barisan Mountains. The legend acts as a mnemonic device for the community to remember a period of intense localized upheaval.

2. Literary Reception and Sociological Impact

The **Reception Theory**(Rezeptionsästhetik) applied to the legends of Si Losung and Si Pinggan reveals how the community in North Sumatra internalizes these stories as more than mere entertainment. Research indicates that these legends serve three primary functions:

- Didactic Value: Warning against fraternal discord and the destructive nature of ego.
- Cultural Identity: Linking the physical landscape of Tapanuli Utara to a specific lineage and historical narrative.
- Geological Awareness: Indirectly acknowledging the volatile nature of the soil in a region prone to seismic shifts.

Studies on the reception of these legends show that despite the prevalence of modern scientific education, the

mythic explanation persists because it provides a human-centric meaning to the seemingly random and terrifying forces of nature. The **literary reception** of these legends ensures that the names "Silosung" and "Sipinggan" remain anchored to the geographical locations, preserving the history of the site through centuries of linguistic evolution.

3. Comparative Technical Analysis: Lake Formation Mechanisms

To understand the formation of North Sumatran lakes, we must distinguish between different geological triggers. While legends attribute lake formation to the actions of heroic or divine figures, geophysics provides a more empirical set of data.

Volcanic Calderas vs. Tectonic Pull-Apart Basins

The lakes of Sumatra generally fall into three categories of formation, as outlined in the following technical breakdown:

Lake Type	Formation Mechanism	Primary Example	Geological Context
Volcanic Caldera	Collapse of a magma chamber following a massive eruption.	Lake Toba	Toba Catastrophe (74,000 BP)
Tectonic Pull-Apart	Subsidence along a strike-slip fault line (Sumatran Fault).	Lake Singkarak	Transpressional Tectonics
Volcanic-Tectonic	A hybrid of faulting and localized volcanic activity.	Tao Silosung / Sipinggan	Localized Tapanuli Upheaval

Lake Toba represents the extreme end of the spectrum. Its formation involved the ejection of approximately 2,800 cubic kilometers of **rhyolitic tuff**, leading to the collapse of the earth's crust. In contrast, **Lake Singkarak** in West Sumatra was formed by the movement of the Sumatran Fault, creating a depression as the two plates moved laterally. The **Tao Silosung** and **Tao Sipinggan**formations are likely related to localized seismic events or small-scale volcanic vents within the Barisan range.

4. The Physics of Hydro-Geomorphology

The transition from a dry depression to a perennial lake involves complex hydrological variables. For the depressions mentioned in the legends of Si Losung and Si Pinggan to become permanent lakes, the following **Mathematical Model for Lake Water Balance** must be satisfied:

9E2 Ò ² uö–â ² " Ò „R ² uö÷WB ² ò•

Where:

- 9E3 Change in storage (volume).
- P: Precipitation falling directly on the lake surface.
- G_in: Groundwater inflow.
- R: Surface runoff from the surrounding catchment area.
- E: Evaporation from the lake surface.
- G_out: Groundwater outflow (seepage).
- O: Surface outflow (rivers or streams).

In the case of Tao Silosung and Sipinggan, the high precipitation rates of North Sumatra (often exceeding 2,500mm annually) ensure that even small depressions can maintain a stable water level, provided the soil composition is sufficiently impermeable (often due to volcanic ash layers acting as a liner).

5. Comparative Case Study: Lake Singkarak and Tsunami Risks

While often overlooked compared to coastal tsunamis, inland lakes like **Lake Singkarak** are susceptible to **lacustrine tsunamis**or seiches. These are standing waves in an enclosed or partially enclosed body of water. The geological history of Singkarak shows that seismic activity along the fault can trigger underwater landslides, leading to sudden water displacement.

Comparison of Lake Toba and Lake Singkarak Attributes

Metric	Lake Toba	Lake Singkarak
Origin	Supervolcanic (Caldera)	Tectonic (Pull-apart)
Surface Area	1,130 km²	107.8 km²
Maximum Depth	505 meters	268 meters
Endemic Fauna	Neolissochilus thienemanni	Mystacoleucus padangensis (Ikan Bilih)
Seismic Risk	Resurgent Dome Uplift	Fault Line Rupture

The presence of the **Ikan Bilih**in Lake Singkarak is a notable biological marker. This fish is highly adapted to the specific mineral content of tectonic lakes. Any disturbance in the lake's geological stability—such as the events described in the Silosung/Sipinggan legends—would have catastrophic effects on such specialized ecosystems.

6. Structural Geology of the Tapanuli Region

The region of **Tapanuli Utara**, where the Si Losung and Si Pinggan lakes are located, is characterized by a high density of **lineaments** and fault traces. The **Renun-Angkola segment** of the Sumatran Fault is particularly active here. Technical surveys of the area indicate that the soil is composed largely of **Andesitic** and **Rhyolitic**materials, the results of millennia of volcanic deposition.

Step-by-Step Geological Evolution of Localized Basins

1. Stress Accumulation: Tectonic forces build up along the strike-slip fault due to the subduction of the Indo-Australian plate beneath the Eurasian plate.
2. Rupture Event: A seismic event causes a localized collapse or "sag pond" effect. In folklore, this is the moment Datu Dalu and Sangmaima engage in their battle.
3. Depression Formation: The physical displacement of earth creates the basins (the Mortar and the Plate).
4. Hydrological Infill: Natural springs and rainfall fill the depressions, creating the Tao (lakes).
5. Stabilization: The lake reaches a steady state where inflow equals outflow and evaporation.

7. Troubleshooting and Mitigation in Lacustrine Environments

For engineering and environmental management in regions like Silahan or Singkarak, several operational challenges must be addressed. These are often the modern equivalents of the "struggles" depicted in the legends.

Common Environmental Failure Modes

- Eutrophication: Excessive nutrient runoff (nitrogen and phosphorus) leading to oxygen depletion. Solution: Implement strict riparian buffer zones and manage agricultural runoff.
- Sedimentation: Erosion from surrounding hills filling the lake basin. Solution: Reforestation of the catchment area and construction of check dams.
- Seismic Seiches: Large waves caused by earthquakes. Solution: Hazard mapping and early warning systems for communities living on the shoreline.

8. The Scientific vs. Legend Dichotomy in Modern Education

In contemporary Indonesian education, the **Science VS Legend** debate is often reframed as a complementary

relationship. While science provides the *how* (tectonics, volcanic collapse), legend provides the *why* (social values, ancestral memory). The story of **Toba** and the **Goldfish** (Ikan Mas) or **Samosir** eating his father's lunch are not just myths; they are narratives that emphasize the fragility of the environment and the consequences of breaking social or natural taboos.

Technical documentation of these sites must include both the geological data (bathymetry, mineralogy) and the ethnographical data (folk stories, local nomenclature) to provide a holistic view of the landscape. This approach, known as **Integrated Landscape Management**, ensures that conservation efforts are culturally sensitive and scientifically sound.

As we look toward the future of the Tapanuli and West Sumatra regions, the preservation of these lakes—both the massive Toba and the smaller Silosung and Sipinggan—depends on our ability to respect the geological forces at play. Whether we view the depressions in the earth as the result of a brotherly feud involving a stone mortar or as the result of a transpressional tectonic shift, the result remains the same: a unique, fragile, and historically rich ecosystem that defines the spirit of North Sumatra. The continued study of these lacustrine systems will undoubtedly yield further insights into the complex dance between the earth's crust and the human imagination.

The enduring legacy of Datu Dalu and Sangmaima serves as a reminder that our landscape is not static. It is a record of movement, energy, and transformation. By bridging the gap between technical geological analysis and the rich tapestry of North Sumatran folklore, we gain a deeper appreciation for the ground beneath our feet and the stories that keep our history alive.

Tags: #North Sumatra #Geomythology #Lake Toba #Lake Singkarak #Sumatran Folklore