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IDENTIFICATION OF GEOMORPHOLOGY AND LITOLOGY BASED ON ANALYSIS OF LANDSAT-8 SATELLITE IMAGES IN PADANG CITY

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ABSTRACT: The application of remote sensing to obtain better quality and up to date maps is needs to be done through the utilization of lithology and geomorphology in mapping of Padang city. This study aims to obtain a lithological and geomorphological picture of the appearance of Landsat-8 OLI Composite 567 satellite imagery. The research method was carried out by image interpretation data preparation. The results showed the city of Padang has 2 units of landforms from visual interpretation, namely **fluvial** and **denudational** landforms. Lithology identification in Padang using geological imagery and maps as a reference succeeds to acquire geological and lithological units, namely: **Alluvial Fan** which is smooth texture, lowland topography, hue and color is bright, parallel river flow patterns, sparse vegetation, river area associations. **Non-decomposed flow** texture is rather rough, hilly topography, hue and color is dark, radial river flow patterns, dense vegetation, associated with forests. **Andesite** has a rather rough texture, highland topography, hue and color is dark, radial river flow patterns, dense vegetation, associated with mountainous terrain. **Alluvial** is found in coastal areas, lakes and sandy areas, fine texture, lowland topography, alongside large rivers with valley, has a bright color and hue, its flow patterns are parallel, sparse vegetation, river area associations. **Hardened Crystal Tuff** with a rather rough texture, topography in mountainous areas, hues and color is dark, radial river flow patterns, dense vegetation, hill area associations. **Volcanic Rock** has a rough texture, high terrain topography, has dark colors and hues, radial river flow patterns, has dense vegetation, and is associated with mountains.

Keywords: Lithology, Geomorphology, Remote Sensing Imagery Interpretation

1. INTRODUCTION

The application of geomorphology in research and mapping is a long-standing problem. This is due to the interest of geomorphological-map markers in landforms—viewed from an lenetic or environmental perspective—in order to present an adequate map of landforms (Hoffman and Louis, 1975 in Sutikno, 2014). Complex landscapes change from year to year due to the influence of seasonal variations, important changes, tidal ranges etc., knowing that allows mapmakers to provide maps of better quality (Syam et al, 2012)

Lithology is the science of describing rocks in outcrops based on their characteristics. Lithology is also defined as the study of the characteristics of rocks. Each rock has characteristics and special characteristics. The nature of these rocks includes the shape, color, hardness, rough or smooth, and whether or not the surfaces of the rock shine. This study aims to create maps of landforms and lithology in the city area of Padang, West Sumatra. The appearance of landform characteristics was mapped. Interpretation using Remote Sensing imagery to identify the geomorphology and lithology of the region through the representation of landforms on the remote sensing imagery based on the characteristics of surface appearances. The geomorphology of Padang City is a combination of Eastern volcanic hills, Middle Eastern fluvial forms and Western marine forms. Lithology limits used is the geological map of the city area of Padang (Verstappen, 1983).

2. RESEARCH METHODS

Referring to the objectives, this study used Landsat-8 imagery with a multispectral band resolution of 30 meters and panchromatic resolution of 15 meters. The time of image acquisition is in 2018, and the geological map used as a reference data.

The methodology is carried out in several stages; **the first is data preparation**, namely the activity before processing or interpretation of satellite imagery. The image data recorded by the sensor is strongly influenced by atmospheric conditions, the angle of data retrieval from the sensor, and the time of data retrieval, which causes the image data to have value bias information that must be corrected through geometric and/or radiometric correction.

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Geometric correction is the process of adjusting pixels in an image with the coordinates of the earth in a flat plane. Landsat-8 imagery used LIT (Level-one Terrain Correction) type, which has been through the process of adjusting sensor and ephemeris data, and using GCP (Ground Control Point) to overcome geometric errors, so there is no need to do geometric correction.

The second stage is data processing, focusing on obtaining good quality images, with sharp and clear displays, especially surface features in geomorphologic extraction and regional lithology with geological map reference. Various methods have been used to improve the quality of the image—especially in sharpening the image— therefore this study conducted a sharp filter to highlight the surface appearance of the study area. This research was conducted with band composite 567 to detect differences in surface appearances or objects drawn (recorded) in the image.

The third stage is image interpretation (visually), includes the stages of reading, classification analysis, and deduction. These stages are not inseparable, but are carried out together. Image reading includes detection, recognition and identification activities. Detection activities view generally the presence or absence of a geomorphological object identified through the shape, size and visual characteristics. Identification is completed by providing geomorphological and lithological names for each object depicted in the image. **Further in the fourth stage an analysis is made** in terms of landform boundaries determination identified through certain pattern shapes.

Geomorphological characteristics used to recognize and identify landforms are hue, pattern, spotting, shape and location of topography and geographical situation. Different objects are depicted in images with different hues. Landforms and lithology have certain patterns in images, landforms have certain forms thus the landform identification can be directly carried out.

The topography of an object is related to the conditions of the slope and height. The slope difference affects the geomorphological intensity. The interpretation of geomorphology and lithology requires knowledge of the regional conditions of the city of Padang i.e. volcanic mountainous regions, lowlands and mountain ridge paths.

The rock formations construct the Padang region are described from the youngest as follows:

2.1 Alluvial (Qal) Consists of mud, clay, gravel sand and shale. Generally found in the mainland, especially on the banks of the river in the swamp deposition area in the North of Tiku, in the Southwest of Lubuk Alung and in the east of Padang. Sometimes there are leftover tufa pumices.

2.2 Non-decomposed flow (Qtau) Rocks consisting of lava, fanglomerate and other coluvium deposits.

2.3 Alluvial (Qal) Silt, sand and gravel are commonly found on coastal plains including swamp deposits north of Tiku, southwest of Lubuk Alung and east of Padang. Sometimes there are leftover tufa pumices.

2.4 Tomp Oligo-Miocene Volcano (Tomv): Volcanic rock with a small amount of sedimentary rock. Volcanic rocks consist of lava, breccias, tuff breccias, tuff crystals, ignites and interstice tuff. Most of them are made of andesitical and dacitical. This interstice tuff consists of shredded andesitic fractions, sandy loam, glass and cherty with a glass bottom mass, soft calcite, quartz and feldspar. Tuff crystal contains a lot of feldspar and quartz with a fundamental solid mass.

2.5 Clay minerals and glass. These include arachoses, bitumen shales, shale coal, tuffaceous sandstones, tuffaceous shales, andesitan tuffs and tuff breccias. In this formation include sedimentary rocks of Early Miocene age which contain fossils of *Dicotylendenblad* in the south of Mount Kerinci. The age of this formation is stated as Oligo-Miocene. Thickness reaches 700 meters. The Painan sheet is called the Painan formation.

2.6 Alluvial fan (Qf) is an appearance in the fan-shaped valley mouth that is the result of the deposition process or is the end of the erosion-deposition system carried by the river where rock crumbs are moved from watertight parts to another part.

2.7 Hardened crystal tuff (QTt): located in the southern part of the mapping area, solid and well cemented. Near the river Buluh is light-colored and consists of a matrix containing many glass fibers with fragments of quartz, plagioclase and volcanic rocks of medium to acidic composition with sizes up to 10 cm. Further south the coloration is light gray-dark gray-green and the composition is more mafic, the matrix is generally chloritic and tuff containing rock fragments of medium to mafic composition besides quartz and plagioclase, there are no glass fibers, there is harmonious contact or fault contact between tuffs and andesite.

3. RESULT AND DISCUSSION

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3.1 Geomorphological Identification of Padang City

The results of identifying the shape of the study area with interpretation elements from the Landsat-8 OLI (Operational Land Imager) composite image 567 could be seen in Figure 1 below:

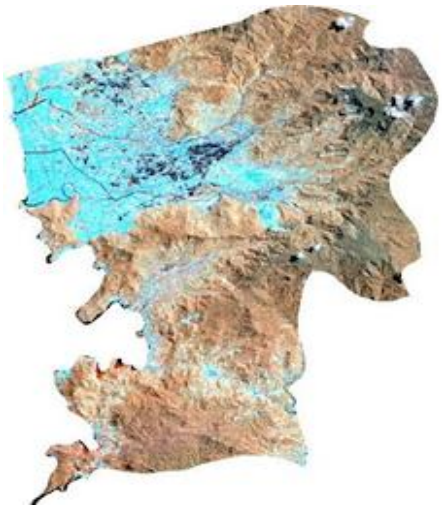

Figure 1. Composite 567 Image Landsat 8 OLI Padang City

The image appearance of composite 567 with the mountainous region has a blackish brown hue, the hilly area has a brown hue while for residential areas or plains have a bluish hue. The geomorphological interpretation of Padang City using the keys and elements of image interpretation is done by visual analysis shown in Figure 2 below:

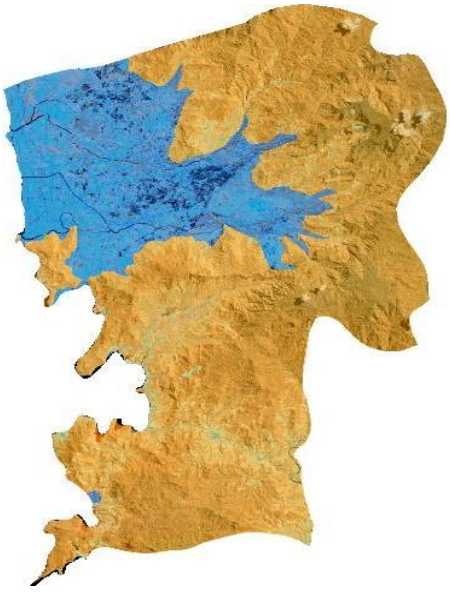

Figure 2. Unit of Padang City Landform

Through visual interpretation it is known that the City of Padang has 2 units landforms i.e. fluvial and denudational landform. The fluvial landform which constitutes the terrain formed by geomorphological processes which are more dominated by exogenous power namely climate, rain curves, wind, rock types, and temperature. All of which will accelerate the weathering and erosion processes.

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The result of erosion is deposited by water to a lower place or following the river flow. The fluvial landform (F) of Padang City is located around lowland coastal areas and valley plains. Denudational landforms are landform units that occur as a result of the degradation process. The Padang City area is dominated by denudational landforms (D) as shown in Figure 3 below:

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Figure 3. Fluvial (F) and Denudational Landforms (D)

Denudational landforms are divided into 3 namely denudational mountainous landforms (D2), denudational hills (D1) and denudational near-terrain (D5). Denudational mountain range results from weathering, erosion, rock mass motion and sedimentation processes that occur due to aggradations. Denudational mountains (D2) are scattered in the northern part of the city of Padang, denudational hills (D1) are scattered in the southern part of the city of Padang, while denudational near-terrain (D5) located between denudational hills. The denudational hills of the Padang City area are mostly eroded as seen from the appearance of patterns, patches and hues. The appearance of composite hues of 567 for this area produces bluish brown hues.

3.2 Lithology Identification of Padang City

Lithology identification is conducted using Landsat-8 OLI imagery and geological maps as a reference to obtain geological and lithological units, namely Alluvial Fan appearance on the image has a smooth texture, topography is found in lowland areas in hilly areas or slope legs, has bright colors, patterns river flows are dendritic, annular, and parallel, vegetation in the area is sparse, and the association of areas around rivers and hills

Lithology identification in Padang is done by using Landsat-8 OLI imagery and geological maps as a reference to obtain geological and lithological units. The unit of **Alluvial Fan** has appearances on the image as smooth texture, topography is found in lowland areas near hilly areas or foot slope, has bright colors, patterns river flows are dendritic, annular, and parallel, vegetation in the area is sparse. The association is the area around the river and the hills.

Geological and lithological units of **Non-decomposed Flow** has a rather smooth texture, topography in low or sloping areas in hilly areas, hue and color is bright brown, annular river flow patterns, vegetation is classified as dense or compact and has an association with hills. The geological and lithological units of **the Andesite** have a rather rough texture. The topography is in the mountainous or wavy terrain, bright brown hues, dendritic river flow patterns, dense vegetation, and associated with mountainous or hilly areas.

The geological and lithological units of **Alluvial** are generally found in lowland areas of the coast, lakes and sandy areas, have a smooth texture, topography is in flat lowland areas, alongside large rivers with valley, have bright hues and colors, their flow patterns are parallel, vegetation are classified as sparse. The associations are found in river and settlement areas.

The geological and lithological units of **Hardened Crystal Tuff** has a rather rough texture, topography is in mountainous wavy areas, hue and color are dark brown, dendritic river flow patterns, and has a relatively dense vegetation. This unit is associated with hill or hilly areas. Geological and lithological units of **Volcanic Rocks** have a rough texture, Its topography in high areas of the mountains, has a dark color and hue, dendritic river flow patterns, has a relatively dense vegetation, and the associations are found in the mountains.

4. CONCLUSION

Padang city area interpretation of satellite imagery has denudational and fluvial landforms. Lithology interpreted from remote sensing imagery and geological maps consists of Alluvial (Qal), Non-decomposed Flow (Qtau), Alluvial (Qal) Silt, Tomp Oligo-Miocene Volcanic Tomp (Tomv), Clay and glass minerals, Hardened Crystal Tuff (QTt), and Alluvial Fan (Qf).

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