

## **The Stratigraphic Log drawing using GeoMS Software, Case Study: Semilir Formation, Ngoro-oro Area, Bantul, Yogyakarta**

**Basuki Rahmad<sup>1</sup>, Muchamad Ocky Bayu Nugroho<sup>1</sup>, Sugeng Rahardjo<sup>1</sup>, Muhamad Gazali Rachman<sup>1</sup>, Rahmat Aziz Al Hakam<sup>2</sup>, Muhamad Imam Al Fatah<sup>2</sup>.**

<sup>1</sup>Geological Engineering Departement, UPN "Veteran" Yogyakarta, Indonesia

<sup>2</sup>Informatics Engineering Departement, UPN "Veteran" Yogyakarta, Indonesia

### **Abstract**

The stratigraphic log is the standard method used to display the vertical succession of rock layers from oldest to youngest. Stratigraphic sections can be constructed based on field data and drilling data. There are two stages when using field data to create a stratigraphic cross-section. The first stage is data correction and the second stage is stratigraphic log depiction. Data correction is done manually using trigonometric empirical formulas and the drawing was done using graphic software such as CorelDraw. These stages of course need more time and effort. GeoMS is a simple software that was designed and built for drawing sedimentary and stratigraphic logs. The software focus on field data processing, although it can use core data or well logs, so the user can choose the data source correctly. The aim of using GeoMS is to simplify and speed up work with precise and detailed results so that it is more efficient and accurate. The research is explaining the new technique of stratigraphic log drawing simpler with any type of data. Besides that, the result is still have an accuracy and detail as good as manually drawn. The stratigraphic log of Semilir Formation in the Ngoro-oro area was successfully drawn using GeoMS. The results of the stratigraphic logs are more detailed and precise due to computational work. However, additional columns such as lithological composition, fossil, facies, noted, photos, etc have been another advantages. GeoMS was proven to provide maximum results in a faster time.

**Keywords:** GeoMS, Stratigraphy, Sedimentology, Ngoro-oro



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### **INTRODUCTION**

Drawing a graphic log is a standard method to describe sedimentary rocks at outcrops or from borehole cores (Bouma, 1962). The Field data was covered as rock layer position (Strike & Dip), Slope, Distance from each layer while drilling data was provided from cutting and core information. The most common method to present field sedimentology data is a lithostratigraphic column, which provide a short visualization of vertical variation of the layer, and correlate to other section for interpreting lateral trends (Hoelzel, 2004). The earth scientist such as geologists and sedimentologic are usually draw the sketch of stratigraphic log in the field by hand to visualized the real condition of rocks. All of them are need to converting the sketch in to digital images especially for reports or scientific publications due to quality requirements. In order to digitalize the sketch is not easy as hand drawing and it will be an obstacle for some scientist. Some of them using digital artists to make the digital stratigraphic log with a high intense guide and of course take a much time. Actually, there were some software that build to draw the stratigraphic log digitally. Zervas et al providing a Sedlog software to draw the stratigraphic log, editing and manipulating so easy (Tucker, 1984) and so far, that was the most useful software. The weakness was just only input from stratigraphic thickness data and no color features for lithological view. In addition, the software is not familiar yet to some Indonesian scientists because most of them prefer to draw manually using drawing software such as CorelDraw. This research is trying to present the graphic output of local software that providing some new features in the hope can accommodate the "Indonesian" Earth Scientist needs.

## LITERATURE REVIEW

The graphic log or stratigraphic log is vertical succession of rocks where be found in river, cliffs or drilled layers of rocks in the subsurface. This log is drawn in diagrammatic format that represented of strata from oldest to youngest layer. In general, there is no standard format for making stratigraphic logs drawing (Rahmad et al. 2021). It all depends on the needs and objectives of the data to be presented. The graphic immediately gives a visual impression of the section, and are a convenient way of making correlations and comparisons between equivalent sections from different areas; repetitions, cycles and general trends may become apparent (Rahmad et al. 2021). The character of each layer could be shown from thickness, lithology, sedimentary structures, fossil content, and special features (remarks) so they are must be well visualized. Other important elements like color, lithological symbols, fossil symbols, and special features symbols are mandatory.

Ngoro-oro area is one of the ideal sites to study sedimentology and stratigraphy located in the east of Yogyakarta city. This area covered a Semilir Formation (Rahardjo, 1977). That cropped out very well due to massive excavation (Figure 1). Semilir Formation consists of volcanoclastic sediment such as tuffaceous sandstone, claystone, and lapillus that deposited in deep marine to shallow marine environments. GeoMS software is trying to build a stratigraphic log quickly is through analyzing data until the graphic drawing process. The raw data will be automatically corrected to be fixed data that is used to draw a log. Manipulate and editing the graphic is follow according to user needs.



Figure 1. Semilir Formation out-crop in Ngoro-oro Area

## RESEARCH METHOD

The method of this research including preparation, collecting data, input data, graphic drawing, and export graphics. Field activity was conducted with the standard operating procedure to collecting data covered azimuth, distance, strike, dip, slope, rock description, and photograph (Figure 2). The angle data covered azimuth, strike, dip and slope are measured by geological compass, whereas distance using roll metre. The rock description is describing every information of rock such as color, grain size, composition, sedimentary structures and etc. Along the track, it will be stopped by every observation point where must pick the mandatory data on it. The track is divided into 10 sections with different azimuth and slopes. It is expected to get a data variation as option analyses. The total distance of the track is about 15 meters with all of the sections are designed perpendicular with a strike of rock. In reality, the track depends on field condition so it will make some nonideal data and needs further correction. The collected data will be summarized in the table to make easier inputting steps (Table 1). Input process and graphic drawing are 100% using GeoMS tools covered editing, lay-outing, and exporting. The finishing step can be realized using another software using SVG format data export.



## FINDING AND DISCUSSION

### Input Data

The data were summarized in Table 1 showing a Semilir Formation has a rock layers trend strike  $N95^{\circ}E - N118^{\circ}E$  with an average Dip about  $15^{\circ} - 40^{\circ}$ . Actually, the azimuth of track is cut trough almost perpendicular to strike direction ( $N170^{\circ}E - N202^{\circ}E$ ), so it makes more minimum correction value to fix it. Every single data was imported corresponding to the header column. The name of header column are ms means measured, and cr means corrected. The users are just input the value, and it will compute automatically. The corrected value has been obtained properly for further step. Corrected data covered slope (S), stratigraphic distance (D) and point distance (Dm) whereas the main calculation is the stratigraphic thickness (t). GeoMS providing another feature for data input directly from stratigraphic thickness data where users just only input the thickness value and it will automatically generate the log.

Table 1.

STA		Azimuth	Strike	Dip	Slope	D (m)
from	to					
1	2	$N170^{\circ}E$	86	32	-20	2.5
2	3	$N175^{\circ}E$	90	40	-10	3
3	4	$N180^{\circ}E$	92	35	-5	1.2
4	5	$N195^{\circ}E$	95	30	5	0.5
5	6	$N202^{\circ}E$	96	28	10	2.8
6	7	$N200^{\circ}E$	98	25	2	3.2
7	8	$N201^{\circ}E$	100	22	1	0.9
8	9	$N170^{\circ}E$	105	28	3	0.65
9	10	$N180^{\circ}E$	118	20	5	0.4
10		$N175^{\circ}E$	110	25	2	0.3

STA	azimuth	ms		cr		ms		cr		Distance (m)	Thickness (m)
1	170	86	32	86	32	86	32	86	32	2.5	2.5
2	175	90	40	90	40	90	40	90	40	3	3
3	180	92	35	92	35	92	35	92	35	1.2	1.2
4	195	95	30	95	30	95	30	95	30	0.5	0.5
5	202	96	28	96	28	96	28	96	28	2.8	2.8
6	200	98	25	98	25	98	25	98	25	3.2	3.2
7	201	100	22	100	22	100	22	100	22	0.9	0.9
8	170	105	28	105	28	105	28	105	28	0.65	0.65
9	180	118	20	118	20	118	20	118	20	0.4	0.4
10	175	110	25	110	25	110	25	110	25	0.3	0.3

Figure 2. Input Field Data Table in GeoMS

*Trace Map*

GeoMS providing a traverse map that is auto-generated from input data calculation. This feature is original and not found in other similar software. Actually, some users do not need these features due to simplification and will focused on the stratigraphic log result, but the map is can be helpful for calibrate the result if users found something miss. The data are including azimuth and stop site distance (Dm). The map has 100% accuracy, especially in azimuth and distance. The users can directly check the map to make sure corresponding to the data. The map is auto-scaled depend on the amount of data and how long the distance but users can edit the scale directly with zoom-in and zoom-out features. It was a very easy step and powerful result map, although still needs some editing to make it perfect. Figure 3 showing a final traverse map of the research area with some missing information such as strike & dip's symbol, lithology, and the legend. The information can be added by users depend on requirments.

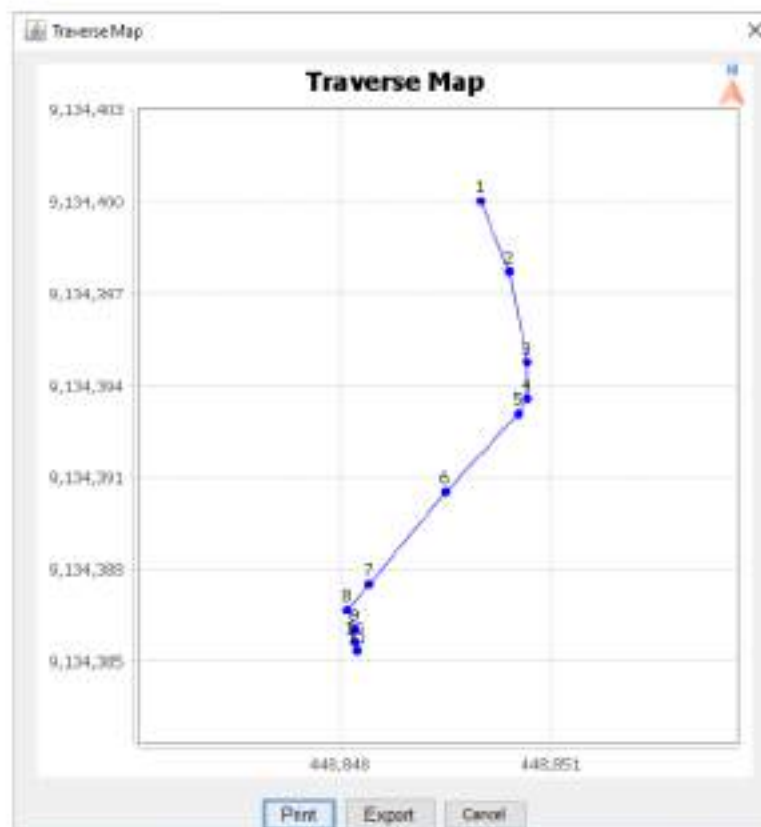


Figure 3. Traverse Map view of data collection

*Stratigraphic Logs*

The standard method for recording and displaying detailed identification of sedimentary rocks in the field and in borehole cores systematically is a Stratigraphic log (Nichols, 2009; Coe, 2010; Tucker, 1984). The graphic logs provide a visual impression of the rocks covered lithology, particle size, bedding contacts, sedimentary structures, palaeo-currents, and fossil content as well as trends such as coarsening or fining upwards (Bristow, 2020). The stratigraphic log was successfully build using input data calculation involving corrected thickness. Just only click OK and choose the sequence direction and it will auto drawing the stratigraphic log but in zero properties. The properties can be added manually by the

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user using several features provided in the Log window. Important properties that users have to fill are lithology, Grain Size, sedimentary structure and rock description. Other information such as fossil contains, photographs and notes could be added depending on user needs. Figure 4 is showing a final stratigraphic log containing six layers with two rock unit, there are Tuff and Tuffaceous sandstone. According to the stratigraphic log, it is can be seen two type stacking patterns, there are coarsening upward continuing fining upward separated by an unconformity. The first sequence tell more about low to middle volcanic activity indicated by the tuffaceous rock unit, whereas the upper one indicates increasing volcanic activity which dominated by the tuff rock unit. The primary sediment structures explaining the transition to a shallow marine environment. More additional data can be added into the column to make better identification about the strata. The vertical scale of the stratigraphic log is the most important property due to visual impression. The scale log depend upon depends upon the amount of rock to be recorded, the level of detail required the complexity of the rocks, and the time available (Bristow, 2020). Several international earth scientists have their own suggested scale, like Arnold H Bouma suggested a scale of 1:1, 1:2, 1:5, and 1:10 (Nouma, 1962), A.L Coe suggested a scale of 1:100 or 1:500 (Coe, 2010) and Charles Bristow used a 1:25 vertical scale (Bristow, 2020). This research is using a 1:20 vertical scale which means 1 m outcrops represented by 5 cm of a log, 0.5 m is 2.5 cm and 0.25 m is 0.5 cm. Actually, GeoMS provide until 1:10 vertical scale resolution to accommodate a thin layer with a detail description.

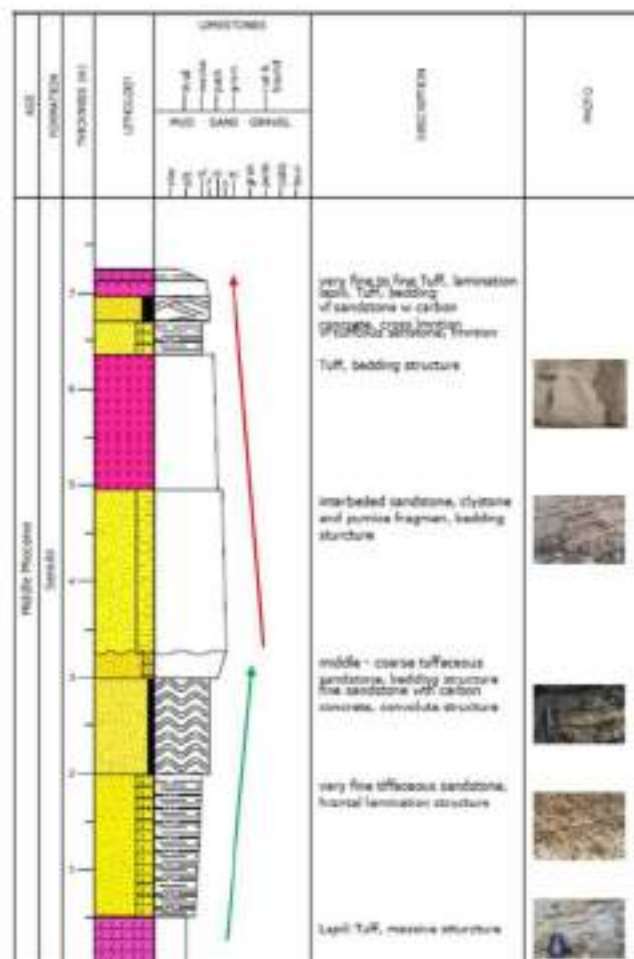


Figure 4. Final Stratigraphic Log covered grain size, lithology, sedimentary structure, and rock description



#### CONCLUSION AND FURTHER RESEARCH

GeoMS software was successfully applied for stratigraphic log drawing using field raw data. GeoMS is free software so everyone can use it with no worry. User-friendly software with simple features and easy steps is the main advantage. The graphic template was quite good but still needs improvisation due to incomplete features. Overall, this software is quite useful and efficient for stratigraphic log drawing. As users, we hope this software continues to develop with new features that can complement the previous shortcomings. So far, GeoMS is still has a limitation that could be improved especially in new features and library symbols. Smoothing graphic and manual editing features is the most possible things to do in near future. Applying artificial intelligence for sedimentology analysis that derived from stacking patterns, fossils content, petrology, etc. is probably can be most high innovation.

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