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[E. M. Murzayev. "LET US REMEMBER THEM WITH A KIND WORD", Soviet Geography, 2013](#)

14-15 November [2018 New paradigm to understanding turbidite sediment in Banyumas Basin](#) [Eko Bayu Purwasatriya\(1\)](#), [Sugeng Sapto Surjono\(2\)](#), [D.Hendra Amijaya\(2\)](#) (1)Geological Engineering, Universitas Jenderal Soedirman and Doctoral Program of Geological Engineering Department, UGM. (2)Geological Engineering Department, Universitas Gadjah Mada bayusatriya@yahoo.com [Abstract. Banyumas basin is one of sedimentary basin in Central Java. Based on surface geological mapping we can found many turbidite sediment in this area. Turbidite sediment is a sedimentary rocks with certain sedimentary structure such as graded bedding, paralel lamination, cross lamination or wavy lamination. Turbidite sediment formed by turbidity current which is caused by the existing of a slope. Several depositional environment which is have a slope can be a candidate as depositional environment of turbidite sediment in Banyumas Basin. Previous researcher always refer it to submarine fan depositional environment, because it is believed that Banyumas is a deep marine in the past time. But in the recent research, we found a buried volcanic arc in the middle of Banyumas Basin, that means there are several volcano formed at the middle of sea in the past time. Turbidity current cause \[by the slope of volcano's flank not the submarine\]\(#\) slope. So the \[new paradigm to understanding the turbidite sediment in Banyumas Basin\]\(#\) is Flysch and molasse turbidite sediment. Flysch is a turbidite sediment related to an orogenic process or the birth of a volcano, and molasse is a turbidite sediment related to reworked process of a volcano, such as weathering, erosion, transportation and then re-sedimentation](#) Keywords: Banyumas;

Flysch; Molasse; Submarine fan; Turbidite 1. Introduction [Banyumas basin is one of sedimentary basin in southern Central Java](#) which [has many geological outcrop showing turbidite sediments](#). Turbidite sediment is a sedimentary rocks with certain sedimentary structure such as graded bedding, paralel lamination, cross lamination or wavy lamination. These sedimentary structure formed by turbidity current and caused by the existing of a slope. It is believed, that Banyumas Basin is a deep marine at the past time, so previous researcher and also its publication always assumed that the depositional environment of turbidite sediments in Banyumas Basin was a submarine fans. Based on the definition, submarine fans is a [fan or cone- shaped submarine features that are accumulations of terrigenous sediment. They are also called abyssal cones, deep-sea cones, submarine deltas, etc. These fans are found offshore from most of the world's great rivers, and extend downward to abyssal depths. Periodic turbidity currents that flush sediments through submarine canyons are responsible for their buildup](#) [1]. Some keywords from the definition are : abyssal, terrigenous sediment and submarine canyon. Submarine fan should be deposited on abyssal depth, the sediment materials are come from land (terrigenous) and it has submarine canyon to flush the sediments from land to deep sea. 14-15 November 2018 Major outcrop of turbidite sediment in Banyumas Basin was from Halang Formation. Praptisih and Kamtono, 2011 studied Halang Formation in Ajibarang area and conclude that facies of the turbidite sediment are C and D from Walker and Mutti's models of mid fan submarine [2]. Setiawan, 2011 also studied turbidite sediment of Halang Formation in Cisanggarung river, Kuningan, and conclude that facies of turbidite sediment are lower fan and middle fan of a submarine fan system [3]. Widagdo, et al., 2015 found the geometry of a submarine fan in Gombong area and predict the source come from Gabon Formation and Kalipucang Formation [4]. Rizal, et al., 2016 study [the Halang Formation in Cibalung area, Cilacap and](#) conclude that turbidite sediment in these area divide into facies [slope, inner fan](#), mid [fan and outer fan of](#) a submarine [fan](#) system [5]. Continued [in](#) 2017, Rizal et al., also studied Halang Formation in Pangkalan river, Banyumas and conclude that turbidite sediment in these area divide into five facies of submarine fan: [proximal channel facies, distal](#) leeves [facies, frontal splay facies](#) 1, [crevasse splay facies and frontal splay facies](#) 2 [6]. Almost all of previous researcher define the turbidite sediment in Banyumas Basin and surrounding area as a submarine fan system. In recent years of author's research, found the buried volcanic arc in the middle of Banyumas Basin [7], that means there are several volcano formed at the middle of sea in the past time. The invention of volcanic arc in the middle of Banyumas Basin also change its paleogeography [8] and also the tectonostratigraphy [9]. So, turbidity current was [caused by the slope of volcano's flank not the submarine](#) slope and there is no submarine canyon that connecting from land to deep sea. 2. Data and [Method The data used in this research are primary data and secondary data. Primary data](#) such as turbidite sedimentary structure from outcrop and some of petrological information from thin section. Secondary data was from literature study related to research's topic. The method used in this research is spotted regional geological mapping to find representative sample regarding turbidite sediment. First data from outcrop regarding turbidite sediment is graded bedding structure (Figure 1). Graded bedding is a sedimentary structure usually on the bottom of a turbidite sequence. The coarser grain will settling to the bottom and the finer grain will remain in the top of bed made a grading pattern from coarse grain in the bottom to finer grain on the top. We can see in figure 1, white fragment in coarser part of the bedding is the tuff lapilli. Tuff lapilli has soft and brittle texture and will be dissapear with long distance sediment transportation. So, the occurence of tuff lapili as a fragment in the graded bedding indicating that turbidite sediment has near source. It will not suitable with term of submarine fan, while the sediment transported along submarine canyon from land to the

deep sea. Next data is a compact sandstone from turbidite sequence contain much of mollusca chip (Figure 2). White mollusca chip in the sandstone bed showing the shallow marine environment. It is also contradictory with term of submarine fan, while the depositional environment of submarine fan should be in the abyssal or deep marine. It is very rare that mollusca chip can reach abyssal environment, because the composition of mollusca chip is calcium carbonate that will be dissolve in abyssal depth (3000 – 6000 meters down). It will be an enigma if we used submarine fan term, but there are beds with much of mollusca chips. Next data from outcrop is a bioturbation in the form of worm's trace (Figure 3). Worm cannot live in the deep sea; a worm's trace that had been fossilized in the claystone with parallel lamination structure indicating that turbidite sediment deposited in the transitional zone or shallow marine. It is also contradictory with submarine fan term, because submarine fan should be deposited in deep sea, whereas worms cannot live. Worm's trace is an ichnofossil and has strong evidence to indicate the depositional environment of a rocks. Other data is from thin section that made from slice of sandstone to observe the petrology of the rocks under the microscope. Figure 4 showing thin section of lithic wacke and figure 5 is feldspathic wacke. Lithic wacke is a sandstone with more than 15% matrix and the fragment is dominated by lithic. In this case, lithic dominated by fragment of igneous rock, indicating the source could be from volcanic area. Important note from this thin section is absent or very minimum of quartz. Quartz is indicating terrigenous material because quartz is resistant mineral and still presence along far sediment 14-15 November 2018 transportation. Figure 5 is another sample of thin section which is dominated by feldspar minerals. Feldspathic wacke is a sandstone with more than 15% matrix and the fragment is dominated by feldspar minerals. Left picture is parallel nicol and right picture is cross nicol; feldspar easier to identify in cross nicol mode, because its feature intercalated of dark and bright lamination. Feldspar indicating volcanic area source and the absent or minimum of quartz also confirm that submarine fan term is not suitable for this area.

3. Result and Discussion

The analysis will combine the data from the field and literature review from previous research. Several questions from data found in the field such as: how tuff lapilli can be a fragment in graded bedding?, how mollusca chip can accumulate in a sandstone bed of turbidite system? and how bioturbation in the form of worm's trace can be occur in the parallel lamination structure? should be answered, because it is contradictory to its tectonic setting that is deep marine. Purwasatriya et al., 2017, had been delineate the volcanic arc in the middle of Banyumas Basin (Figure 6). Mio-Pliocene volcanic arc in the middle of basin had supply many volcanic sediments to the basin. The type of that volcano is sub-vulcano which is part of the body below the sea level and the other part of the body is above the sea level. This finding is a milestone and great discovery, because it can be answered all the questions and change the historical geology of the basin to date. The occurrence of volcanic arc in Miocene to Pliocene describe how the tuff lapilli can be a fragment on graded bedding. The turbidite systems in Banyumas caused by the slope of volcano's flank, so the tuff lapilli doesn't need to transported far away from its source and this is answered the first question. The arise of volcano arc also change some of depositional environments locally, so not all deep marine, but the rapid sedimentation of volcanoclastic material make the depositional environment along the arc become shallower. This describe answering the second question, why there is a lot of mollusca chip in a sandstone bed of turbidite system, because locally, along the volcanic arc, there are shallow marine environment where mollusca occur. This description also answering the third question, why bioturbation occur on the top of parallel laminated shale of a turbidite system, because locally along the arc also there are transition zone and land, when the volcano above the sea level. After answering the questions from the field data, we know that it is not correct

to use the term submarine fan to describe the [turbidite sediment in Banyumas Basin](#). We need [new paradigm to understanding turbidite sediment in Banyumas Basin](#), that is flysch and molasse. Flysch is [a sedimentary deposit typically consisting of a thick sequence of interbedded marine shales and graywacke sandstones, which were deposited by turbidity currents and display graded bedding](#). Flysch [is thought to be derived from the erosion of rapidly rising fold mountains and is itself deformed in the later stages of the orogeny](#). It is therefore a syntectonic deposit. The term was first defined in relation to Alpine rocks, but its use has been extended to other orogenic belts [1]. [Molasse is an association of conglomerates and sandstones deposited as alluvial fans and lacustrine deposits. Rocks of the facies are associated with](#) most mountain ranges [and are post-tectonic](#) deposits [1]. Based on the definition of flysch and molasse, at least there are two points to distinct flysch and molasse, first is rocks association and second is the time of its occurrence (syn orogeny or post orogeny). Although in definition flysch called as syn-tectonic deposits and molasse called as post-tectonic deposits, but in my opinion it is better to related it to the orogeny than tectonic. Flysch deposit found in the outcrop of Banyumas Basin (Figure 7), intercalating of marine shale and wacke sandstones. The sandstones has high morphology than marine shales, because its resistance to weathering and erosion, so the morphology of the sequences alternately high and low. Molasse deposits also can be found in the outcrop of Banyumas Basin (Figure 8), association of conglomerates or breccia and sandstones. The sandstones usually has coarser grain than sandstones in flysch deposits. 14-15 November 2018 4.

Conclusion Conclusion of the research are as follow: ? The term of submarine fan is no more suitable to describe [turbidite sediment in Banyumas Basin](#) ? [New paradigm to understanding turbidite sediment in Banyumas Basin](#) are flysch and molasse deposits Acknowledgement Thank you for Geological Engineering Universitas Jenderal Soedirman (UNSOED), Geological Engineering Universitas Gadjah Mada (UGM) and special thanks for funding to [Direktorat Riset dan Pengabdian Masyarakat, Direktorat Jenderal Penguatan Riset dan Pengembangan Kemenristek Dikti](#)

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November 2018 Figure 1. Graded bedding structure in Banyumas Basin with tuff lapilli fragments (white fragments) Figure 2. A sandstone bedding from turbidite sequence contain much of mollusca chips (white chips) 14-15 November 2018 Figure 3. Bioturbation in the form of worm's trace (red circle) indicating transitional environment Figure 4. Thin section of lithic wacke dominated by lithic from igneous rocks 14-15 November 2018

Figure 5. Thin section of feldspathic wacke in Banyumas Basin JAVA Figure

6. Delineation of magmatic/volcanic arc in Banyumas Basin (Purwasatriya et al., 2017) 14-15 November 2018 Figure 7. Flysch deposit in Banyumas Basin, intercalating of marine shale and wacke sandstone Figure 8.

Association of conglomerates and coarse sandstone as molasse deposits in Banyumas Basin [1st International Conference on Multidisciplinary](#)

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