Indication Strike Slip Movement a Part of Sorong Fault Zone in Yapen Island, Papua, Indonesia

Fahmi Ikhwanudin and Chalid Idham Abdullah

***Abstract*-Sorong Fault Zone is located at northern of the Papua Island. It is moving from the body bird of Papua Island toward south-southeast of Molluca Island, spreading to east part of Celebes Island, and overstepping east part of Yapen Island which occupied the Bird's Neck of Papua. The fault became a border between Caroline oceanic plate (part of pacific oceanic plate) and Australian continental plate. Instead, The Sorong Fault Zone controlled forming of Salawati Basin in west of Yapen Island. The Sorong Fault, Lengguru Fold thrust belt, Tarera-Aiduna Fault, and Seram Thrust are structural features which associated with the collision between the Australian continental plate and the Pacific oceanic plate at Oligo-Miocene as regional uplift.**

This paper explains the indication trace of Sorong Fault Zone in research area, there are shear zone, minor fault, brecciation zone, and lineament in Cataclastic Breccia Formation. The research was conducted in the Sumberbaba area, Yapen Timur sub-district, Yapen Waropen district with fieldwork as the main method. The Sumberbaba area is located appropriate in fault line of Sorong Fault Zone. The general structure pattern that worked in research area is northwest-southeast direction with strike-slip movement. The lithologies at the area are Cataclastic Breccia in late Miocene, tuffaceous sandstone and tuffaceous breccias for Volcanic Yapen Formation in late Eocene to early Miocene, limestone for Wurui Formation in early Miocene, and sandstone Kurudu Formation in early Pliocene.

Structural analysis in this area was done by using the measurement method of collecting structure evidence. There are shear fracture and extension fracture in rock outcrop. The characteristics of fault should have shear orientation or strike of shear plane, dip direction, and slickenside. The majority of lineaments are in NW-SE direction, lineament orientation at the fault in research area in NW-SE (almost W-E) and it is appropriately following the Sorong Fault Zone.

Keyword-Sorong, Fault, Orientations, Structure, Cataclastic, Yapen

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I. INTRODUCTION

The Sorong fault is a major left-lateral fault system that extends eastwards through northern New Guinea and westwards as far as Sulawesi (the Sorong Fault Zone in the sense of Hall and others). The age of initial movement on the Sorong system has been variously estimated between Oligocene and mid-Pliocene, with most of the estimations placing the main phase of movement in the mid Miocene-Pliocene [1]. A minimum displacement of about 850 km can be inferred from main fault strand south of Banggai-Sula structural block based on relocation of the Tomori Basin in eastern Sulawesi, north of Salawati Basin in the northern Bird's Head [1].

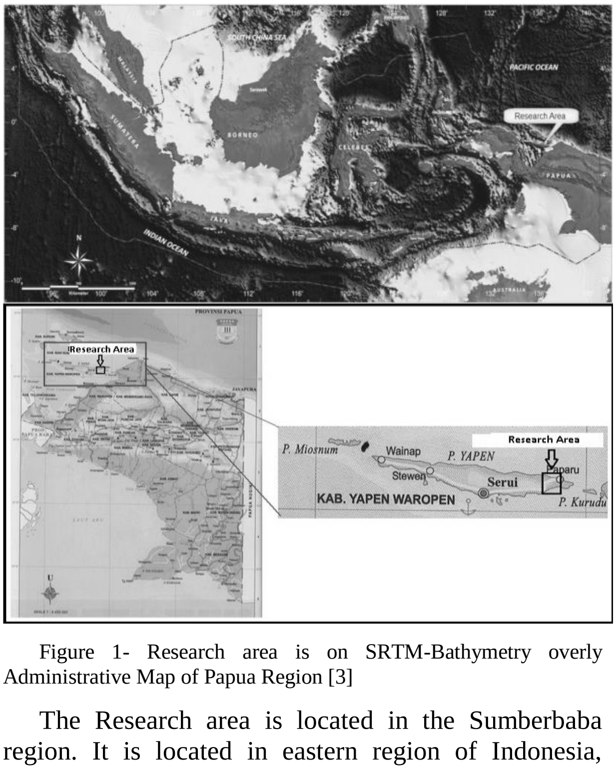


Figure 1- Research area is on SRTM-Bathymetry overly Administrative Map of Papua Region [3]

The Research area is located in the Sumberbaba region. It is located in eastern region of Indonesia, particularly in Yapen Island in Bird's Neck of Papua. Geographically, this region is located at the coordinates

UTM 53-S between 684000-692000 E and 9799000-9809000 N. This research area has a wide of 80 km^2 (8 km x 10 km), including the village of Dawai and Aisau, East Yapen sub-district, Yapen Waropen district, Papua Province, Indonesia (Figure 1).

The detail of geological condition and geological structures are interesting. Unfortunately, only a few authors have been discussing especially in Yapen Island.

The purpose of this research is to discover the geological setting of the research area, including geomorphology, stratigraphy, geological structure, and the geological history, not to mention especially structural analysis and indication trace of Sorong Fault in the research area (Figure 2).

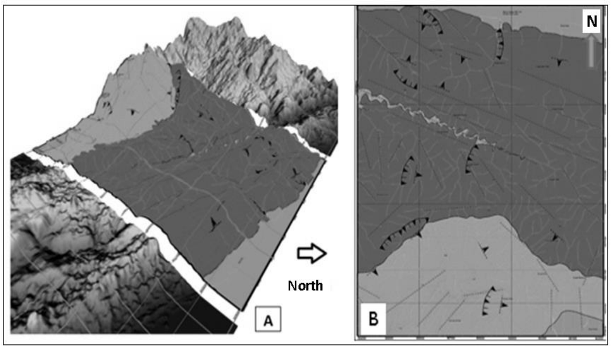


Figure 2- Geomorphological map of research area [4]

II. GEOLOGY OF RESEARCH AREA

A. Geomorphology

The geomorphology in the research area is divided by the Lobeck classification [2]. This classification is based on genetic or process type and factors that influence the morphology of the research area. The geomorphological units of this area can be divided into three units. There are the Structure Complex Mountain, Karts Mountain, and Alluvial Plain (Figure 2). The altitude in this area is around 0-909 m above sea level and geomorphology observed uses Topographic map with 1:50,000 scale and SRTM. Interpreted lineament in hill and mountain obtained general direction of lineament to NW-SE (Figure 3).

B. Stratigraphy

The classification of the stratigraphy unit nomenclature in the research area is based on the observation of the lithology characterization in outcrop and petrography analysis in laboratory. Therefore, the stratigraphy of this area can be divided into five unofficial lithostratigraphy units, from old to young age, tuffaceous sandstone and tuffaceous breccias for Volcanic Yapen Formation in Eocene to Miocene, limestone for Wurui Formation in Lower Miocene, Breccias Cataclastic in lower Miocene, sandstone for Kurudu Formation in early Pliocene, and Alluvial deposits in recent (Figure 4).

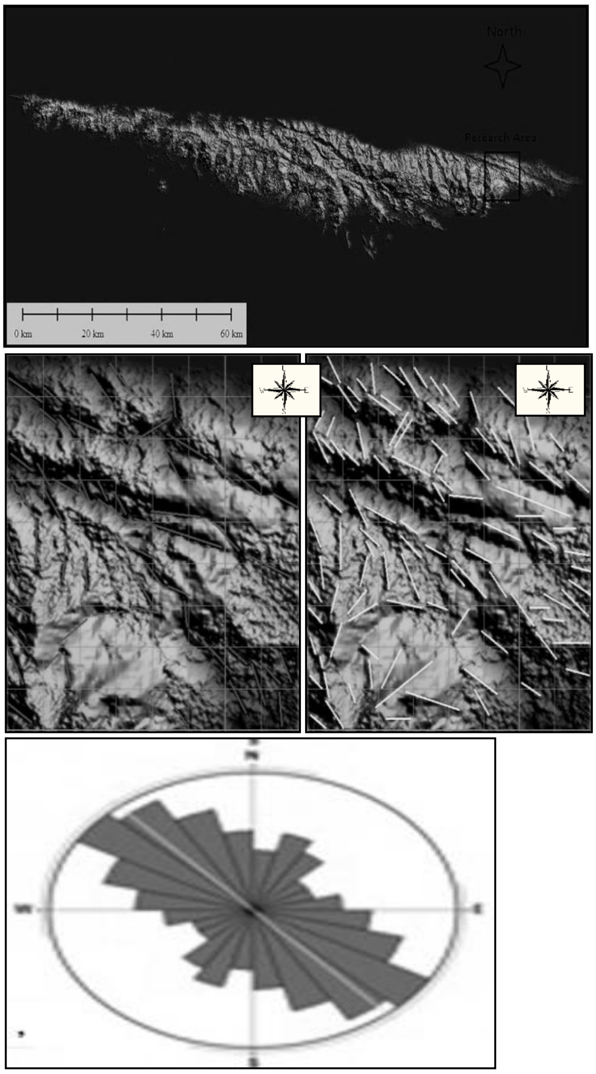


Figure 3- SRTM and rose diagram from lineament analysis in research area [4]

C. Geological Structure

The geological structure in the research area has six structures, five faults and one fold. It is following Rickard classification (2004) and cross-cutting the all litology units. The structures are Jobi strike slip fault, Wajewi reverse fault, Rodani reverse fault, Marora strike slip fault, Wajewi strike slip fault, and Usira syncline (Figure 5A).

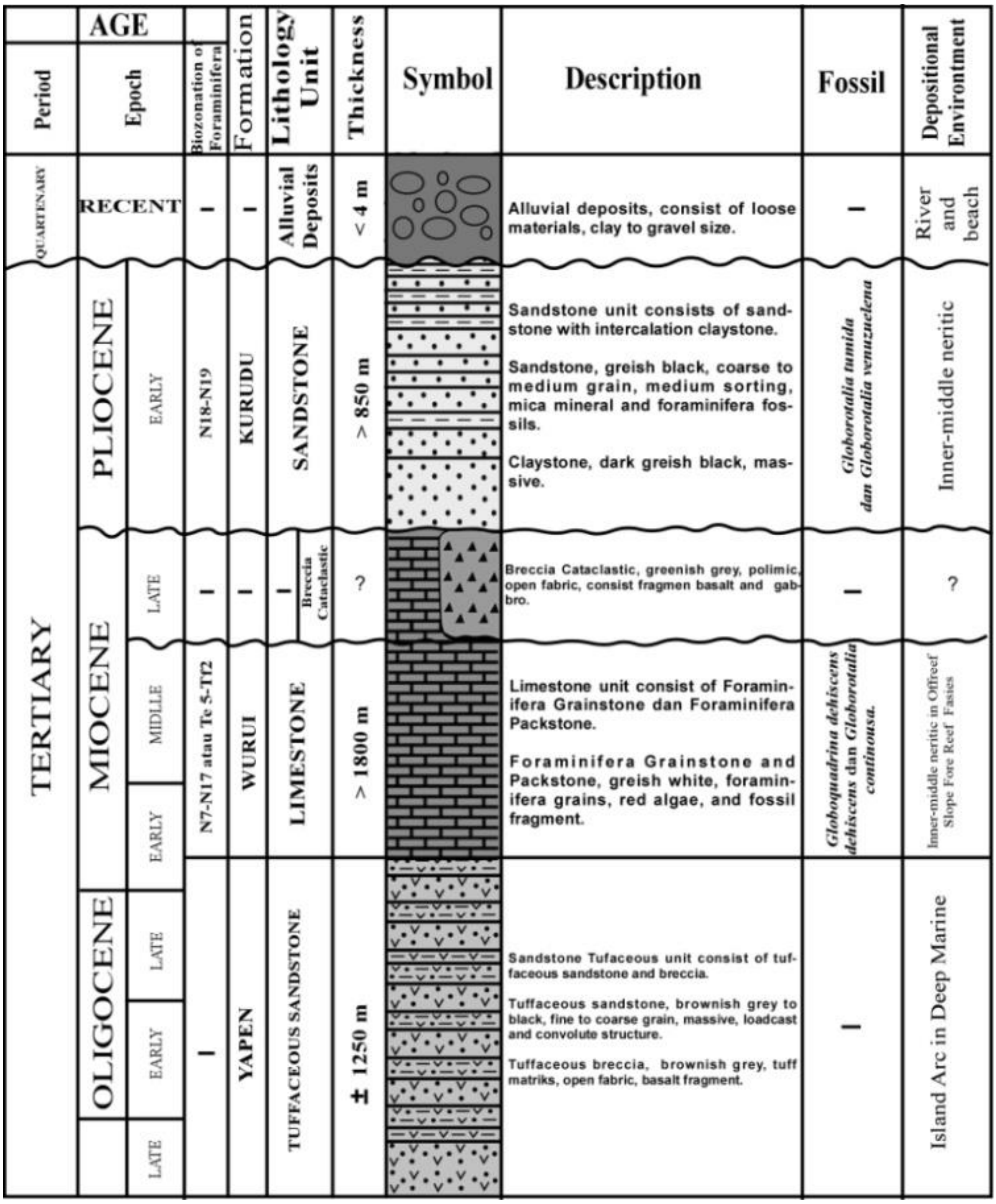


Figure 4-Stratigraphy Column in the research area [4]

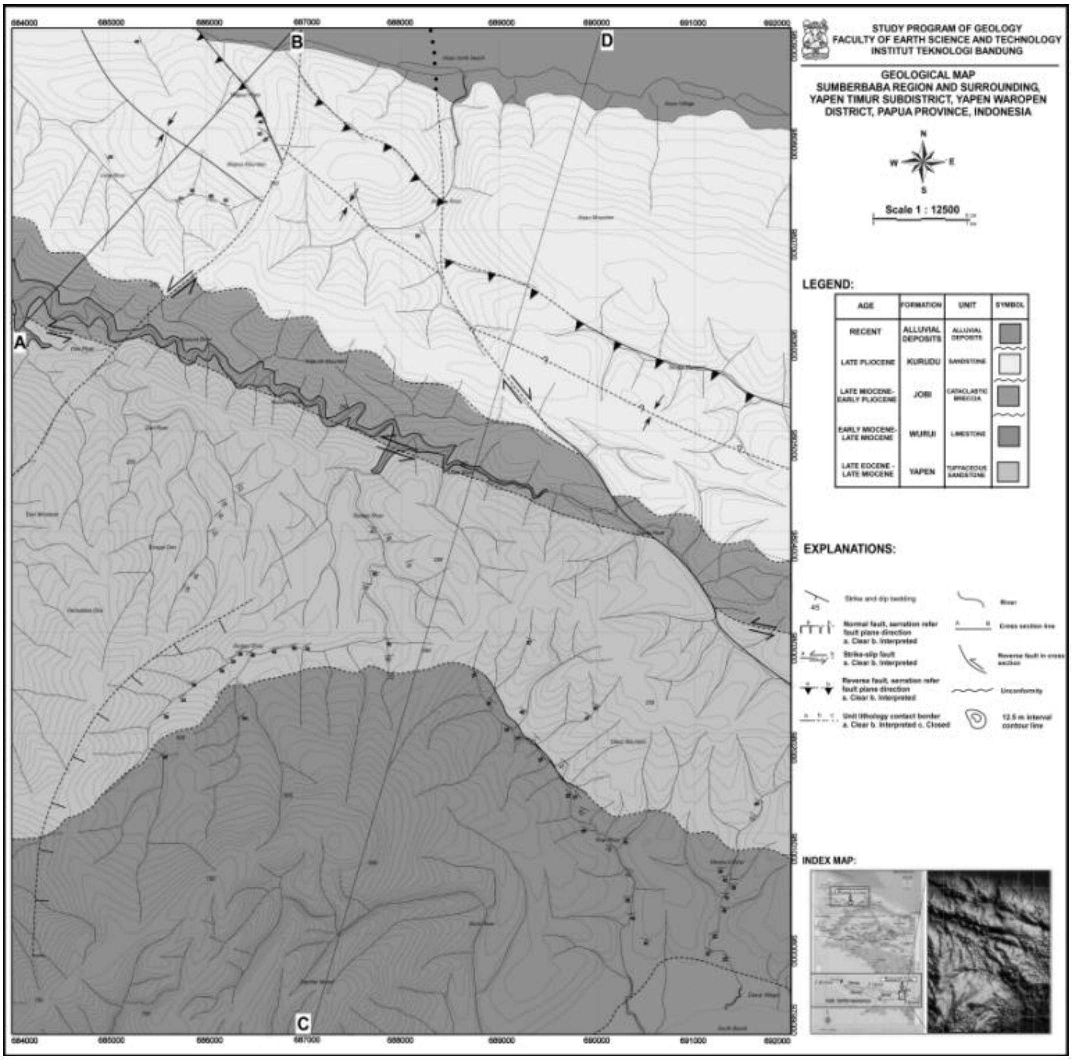


Figure 5.A-Geological Map in the research area [4]

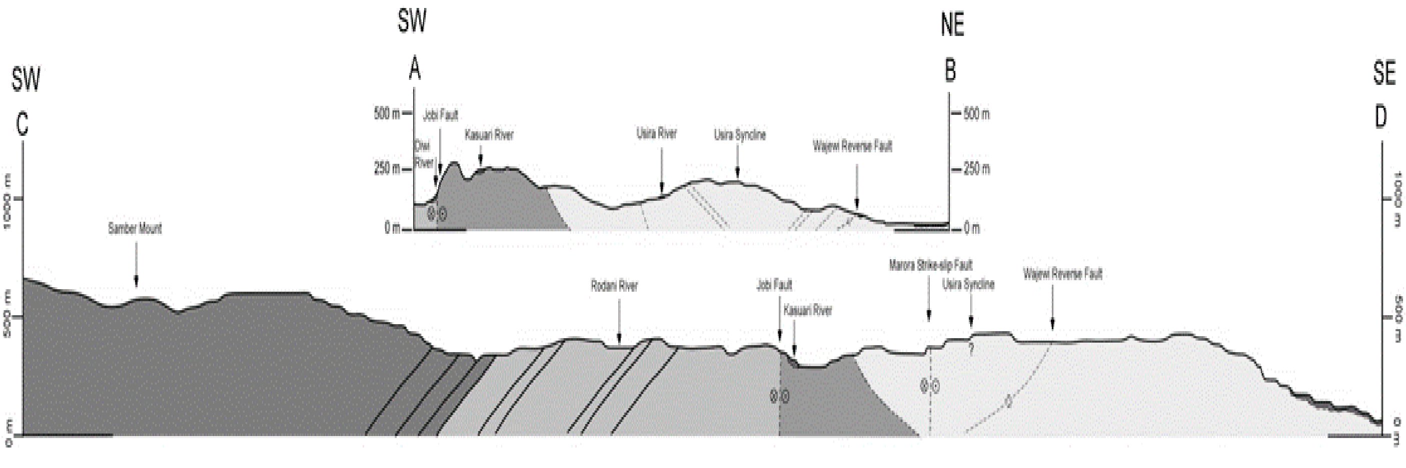
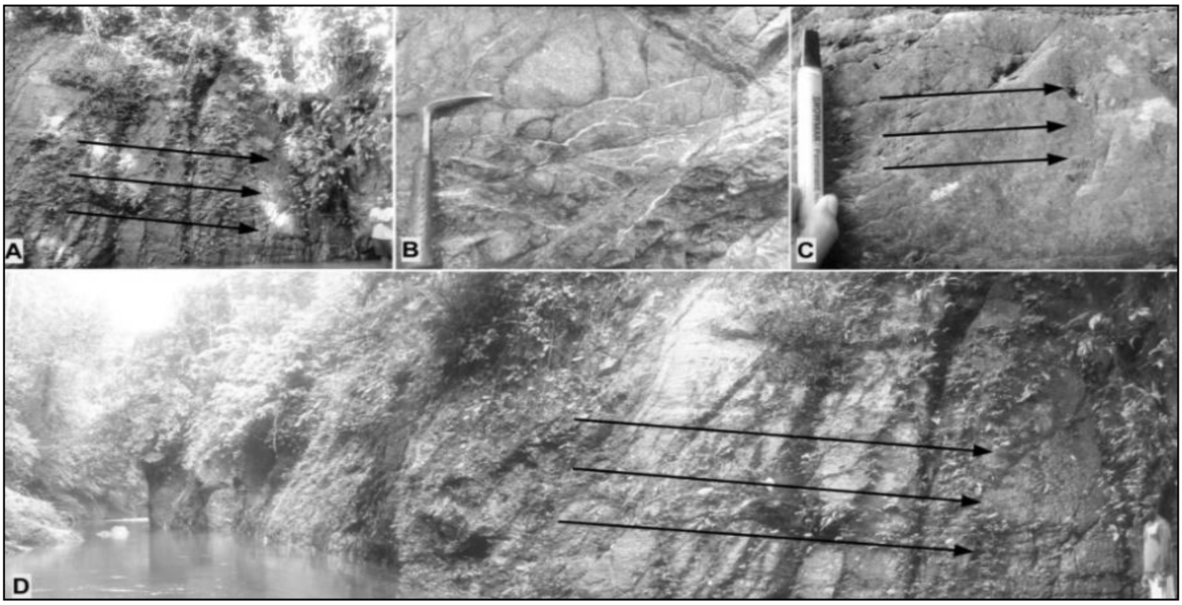
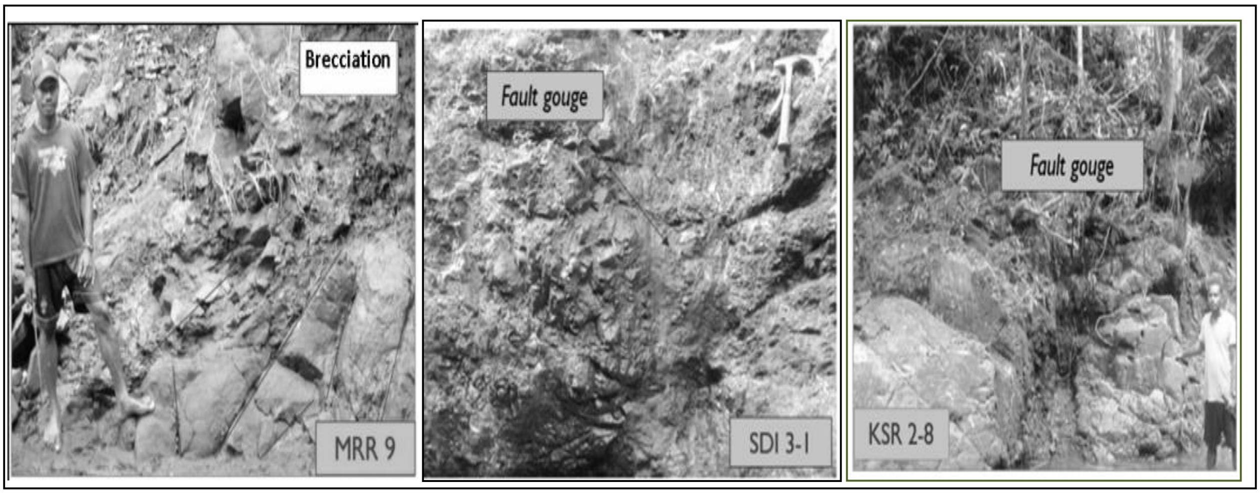


Figure 5.B-Cross section of geological Map in the research area [4]



Picture 1 Jobi strike-slip fault structure evidences. Slickenside (A), gash Fracture (B), slickenside (C), dan escarpment (D) in cataclastic breccia [4]



Picture 2 Several structure evidence in this research area [4]

III. STRUCTURE ANALYSIS AND INDICATION TRACE OF SORONG FAULT

The discussion in this section will be focused to the regional approach regarding the structure analysis and indication trace of Sorong fault. Fault indication can be determined from the presence of shear fracture, extension fracture, brecciation, fault gauge, lineament, minor fault, and so on (Picture 1).

A. Structure Analysis

The shear fracture distribution data are important to interpret geological structure which developed in the research area. It has major 136˚-180˚ distribution of strike shear fracture. It can be mentioned the dominant structure pattern is NW-SE direction. The distribution of dip shear fracture is important to interpret type of structure. In the research area has major 51˚-60˚ distribution of dip shear fracture. It can be determined the main type fault is strike-slip system because it has high angle (Figure 6).

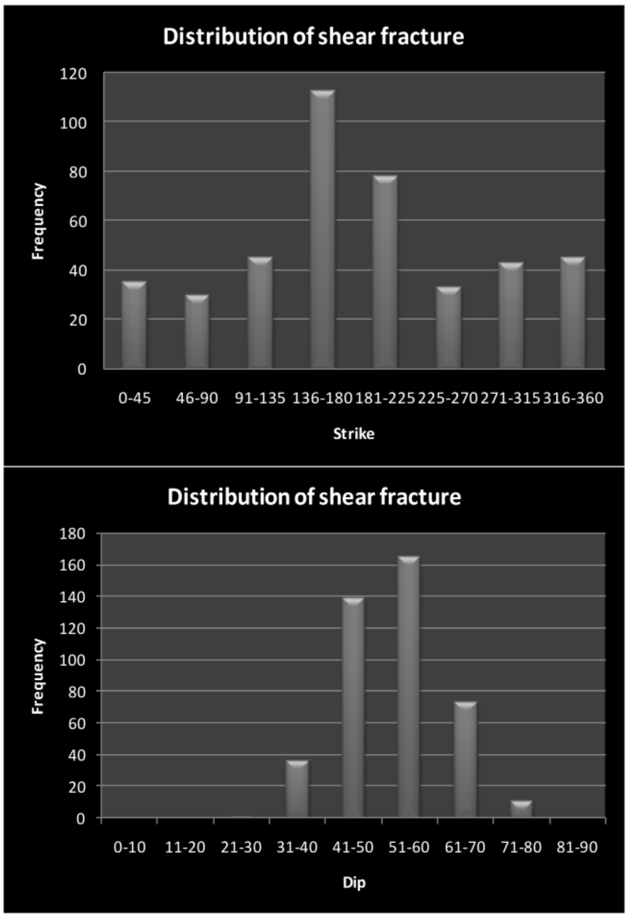


Figure 6-Distributions of shear fracture use strike and dip in research area.

The structure analysis is based on the field outcrop and kinematic analysis. It has six structures. There are Wajewi reverse fault, Jobi strike slip fault, Marora strike slip fault, Wajewi strike slip fault, Rodani normal fault, and Usira syncline (Figure 7). The Wajewi reverse sinistral-slip fault interpreted from SRTM lineament, escarpment, shear fracture, extension fracture, brecciation, and from kinematic analysis obtained N134˚E/59˚SW fault plane; 43°, N350°E net-slip, and 53° pitch. The Jobi sinistral-slip fault identified from SRTM lineament, dissected ridge morphology, brecciation, shear fracture, extension fracture, slickenside, and lens texture from petrography analysis. The Marora dextral reverse-slip fault interpreted from lithology offset and brecciation. This fault has two lineaments based on kinematic analysis. There are N175°E/61°SW fault plane; 2°, 350°E net-slip, 5° pitch, and fault plane N136°E/69°SW; 18°, N324°E net-slip, and 18° pitch. The Wajewi dextral reverse-slip fault indicated offset of block in SRTM, fault gouge, and kinematic analysis so that obtained N203°E/70°NW fault plane; 25°, N192°E net-slip, and 27° pitch. The Rodani normal sinistral-slip fault interpreted from abnormal stratigraphy, SRTM lineament, changes orientation of beddings, shear fracture, minor fault, and extension fracture. The Usira upright fold syncline interpreted from kinematic analysis in bedding. It has common N167°E/53°SW and N280°E/37°NE of flanks, N320°E/82°NE axis plane, and N320°E/82°NE fold axis.

B. Fault Trend

Detail analysis of fault lineament (normal, reverse, and strike-slip fault) and fold lineament (syncline) were done by understanding the stress regime structural evolution in this area. The structural lineament was plotted in the Roset diagram and in the Stereonet diagram (Figure 7, See Appendix).

The fault trends in the research area have NW-SE strike-slip fault as major orientation, NE-SW normal fault and fold trend has NW-SE. Based on structure orientation can be interpreted the stress major following simple shear deformation mechanism.

In structure regional, the research area quite influenced from Sorong Fault Zone which has W-E orientation. The force is composite between Pacific plate and Australian plate. Therefore, the structural pattern and fault trend in this research area following major stress from Sorong Fault.

The NE-SW trending cross section of geological map describe the major strike slip fault dominated the structural grains in the Yapen geological setting (Figure 5B). The major fault that can be interpreted as a part of Sorong fault is Jobi fault (Figure 8).

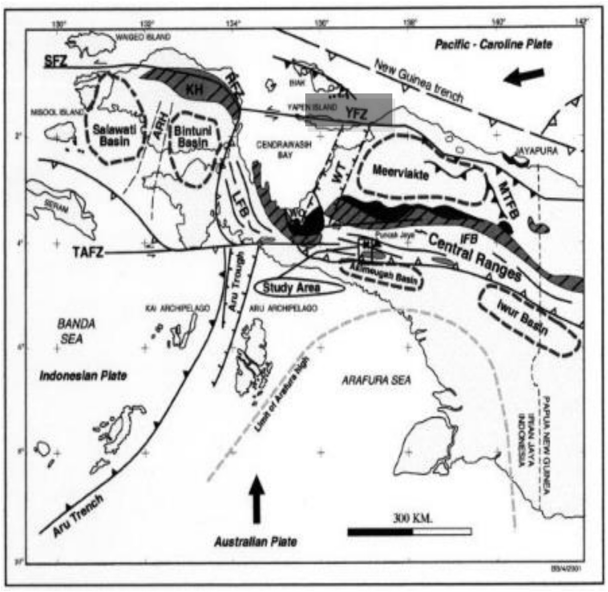


Figure 8-Analogous structure regional in research area [5]

III. CONCLUSION

Based on integrated analysis and interpretation, conclusion inferred as follows:

1. The geomorphological units in the research area can be divided into three geomorphological units: the Structure Complex Mountain, Karts Mountain, and Alluvial Plain.

2. Stratigraphy of the research area consisted of five unofficial litho-stratigraphic unit: tuffaceous sandstone and tuffaceous breccias for Volcanic Yapen Formation in late Eocene to early Miocene, limestone for Wurui Formation in early Miocene, Cataclastic Breccia in late Miocene, sandstone for Kurudu Formation in early Pliocene, and Alluvial deposits in recent.

3. The structure geology in the research area was formed from major stress NE-SW that produce Jobi sinistral-slip fault. The Jobi fault can accommodate former the breccias cataclastic unit. It can be interpreted as a part Sorong strike slip fault which has W-E direction movement.

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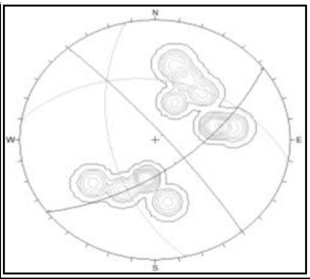
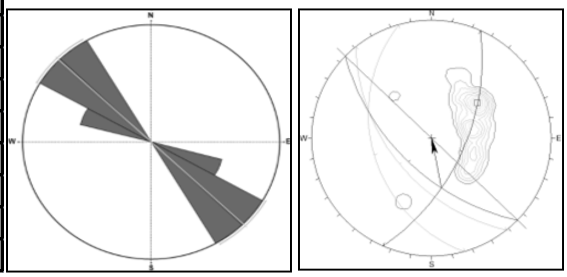
Appendix

No	Strike	Dip	No	Strike	Dip
1	322	60	7	115	58
2	300	51	8	165	49
3	260	55	9	165	48
4	103	65	10	280	35
5	283	38	11	132	55
6	170	60	12	115	38



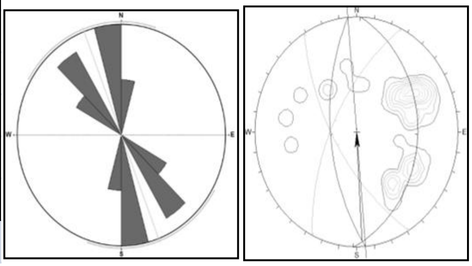
Syncline Usira

No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip
1	141	50	14	168	33	27	224	45	40	200	43	53	146	54
2	164	44	15	228	45	28	153	38	41	205	38	54	195	44
3	164	50	16	149	54	29	100	58	42	184	35	55	339	65
4	168	40	17	130	49	30	137	53	43	175	37	56	185	47
5	293	65	18	146	50	31	138	54	44	143	48	57	200	38
6	198	35	19	165	40	32	114	60	45	128	38			
7	170	40	20	169	35	33	123	48	46	208	50			
8	202	43	21	174	51	34	55	54	47	338	38			
9	120	48	22	125	42	35	145	55	48	42	47			
10	144	48	23	151	34	36	147	53	49	211	44			
11	162	32	24	148	34	37	140	52	50	221	45			
12	145	35	25	294	56	38	117	58	51	220	47			
13	160	48	26	225	40	39	180	42	52	134	49			



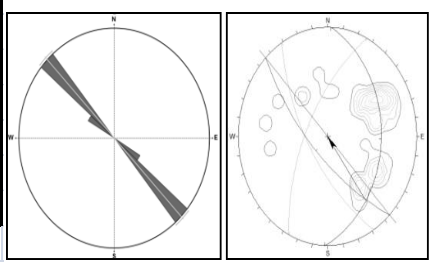
Wajewi reverse dextral-slip fault

No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip
1	148	65	10	146	67	18	145	60	26	149	59	34	212	63	8	150	69
2	160	75	11	166	55	19	140	57	27	153	63	35	212	70	17	156	72
3	130	56	12	144	66	20	151	49	28	141	43	36	214	65	25	200	69
4	147	53	13	169	70	21	164	59	29	151	74	37	170	58	33	30	65
5	150	74	14	138	51	22	200	59	30	210	61	38	240	70	41	350	66
6	50	49	15	85	45	23	100	45	31	190	46	39	234	62	9	10	70
7	80	60	16	55	50	24	230	60	32	232	59	40	230	54			



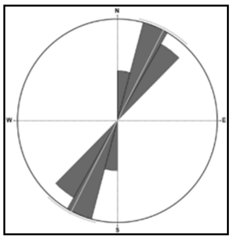
Marora-A dextral reverse fault

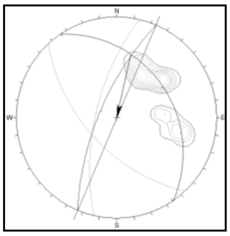
No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip
1	148	65	10	146	67	18	145	60	26	149	59	34	212	63	8	150	69
2	160	75	11	166	55	19	140	57	27	153	63	35	212	70	17	156	72
3	130	56	12	144	66	20	151	49	28	141	43	36	214	65	25	200	69
4	147	53	13	169	70	21	164	59	29	151	74	37	170	58	33	30	65
5	150	74	14	138	51	22	200	59	30	210	61	38	240	70	41	350	66
6	50	49	15	85	45	23	100	45	31	190	46	39	234	62	9	10	70
7	80	60	16	55	50	24	230	60	32	232	59	40	230	54			



Marora-B dextral reverse fault

No	Strike	Dip	No	Strike	Dip	No	Strike	Dip	No	Strike	Dip
1	143	63	7	195	54	13	115	50	19	143	58
2	120	47	8	190	67	14	140	60	20	125	48
3	175	49	9	145	67	15	193	65	21	130	53
4	110	53	10	138	60	16	180	58	22	114	60
5	117	60	11	140	59	17	196	70	23	121	51
6	175	44	12	133	53	18	105	61	24	128	59





Wajewi sinistral reverse fault

Figure 7-Kinematic analysis of structure in several observation points in research area [4]