

8. Satellite image interpretation for geomorphologic survey



Geomorphological Survey  
Satellite image interpretation

(1) Satellite image interpretation for each section

1) Vicinity of ST.0+000 to ST.1+200

A horse-shoe shaped depression surrounds the S-curve in the road near ST.0+000, which is the remains of an old landslide (A). Within that, several smaller landslides, thought to have occurred more recently, can be identified. Within this large landslide there is a smaller landslide formation (B).

Landslide (C) is interpreted as moving in-line with or obliquely—west-southwest—to the road, judging from the mound near the foot of the moving mass.

There is only one river system here, (D), which flows from Gohatsion Town.

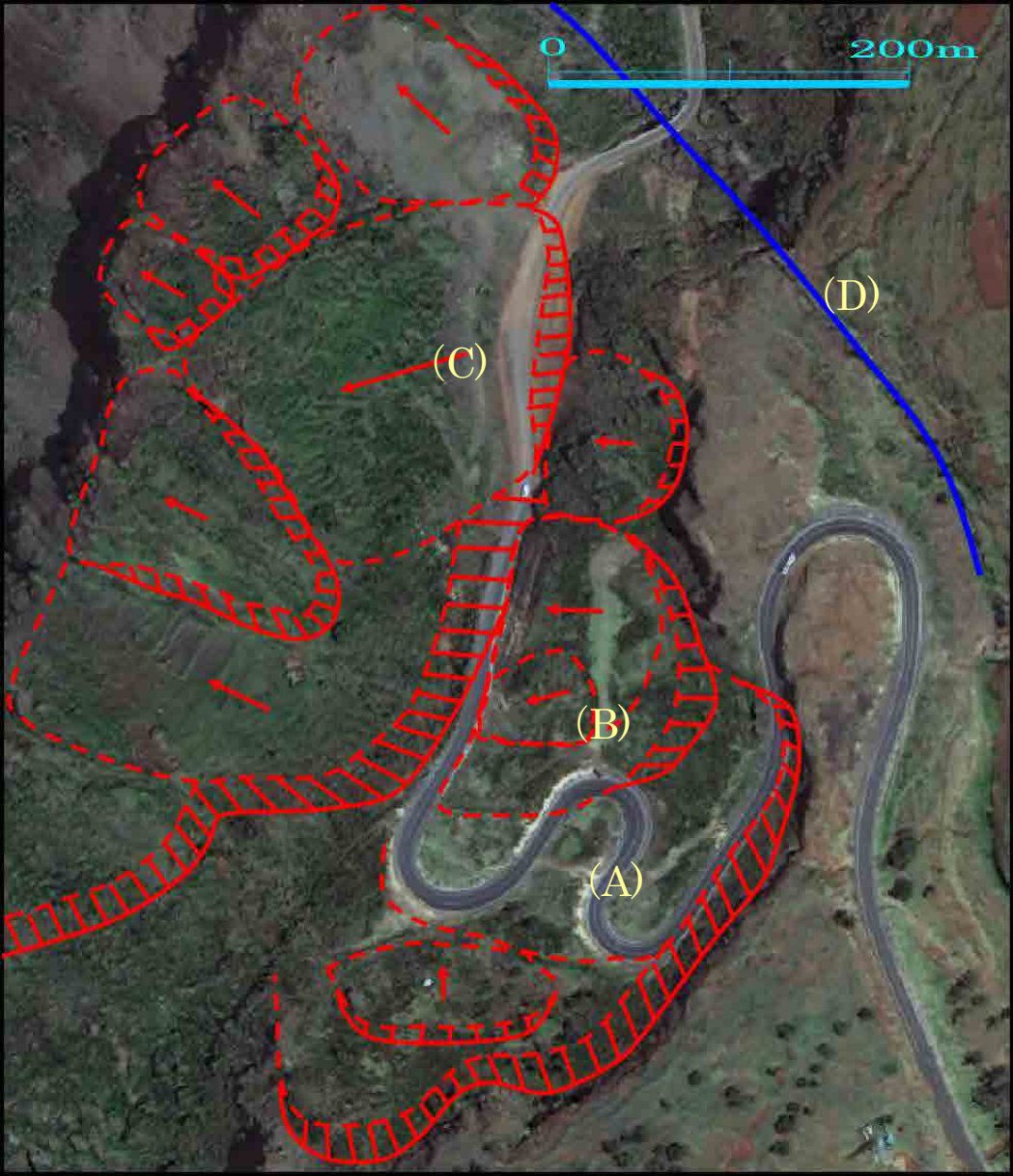


Fig.3.3.4 Satellite image interpretation ST.0+000 to ST1.200

2) Vicinity of ST.1+100 to ST.2+500

There are several medium- to small-scale landslides along the road in this area. Landslides are also confirmed on the basalt lava plateau above the cliff; around which several parallel steps can be confirmed.

Three small river systems (B, C) can be confirmed flowing from the basalt lava plateau, in addition to (A) flowing from Gohatsion Town; however, only one (C) is confirmed to continue to the downstream basin, the other two dry-up along the way.

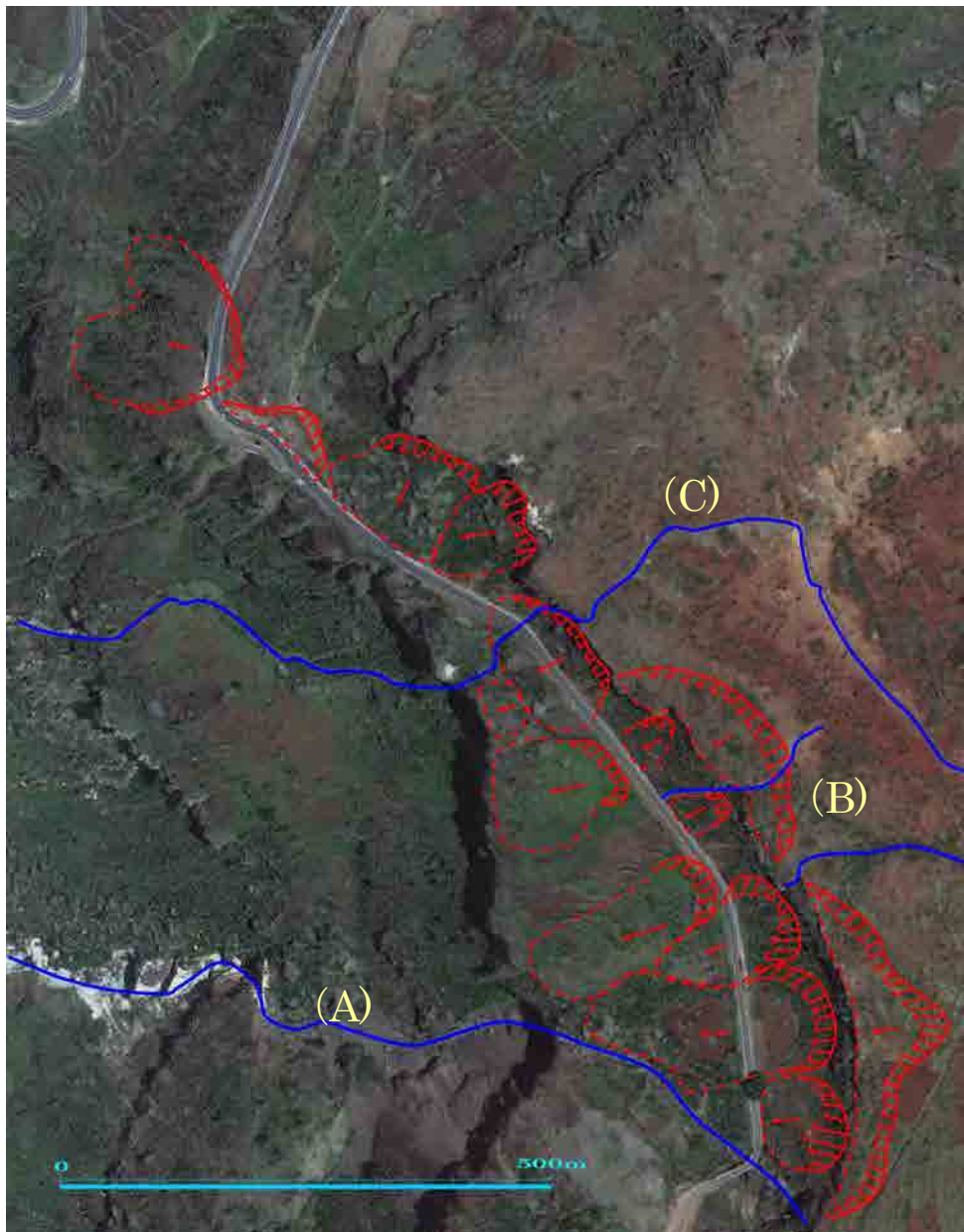


Fig.3.3.5 Satellite image interpretation ST.1+100 to ST.2+500



3) Vicinity of ST.2+400 to ST.6+000

Many large to small landslides can be confirmed in this area. Steps and cracks can be confirmed at (A), and minor deformations are considered to be active. Steps and cracks are confirmed at (B) also. Three river systems can be confirmed in this area (C, D).

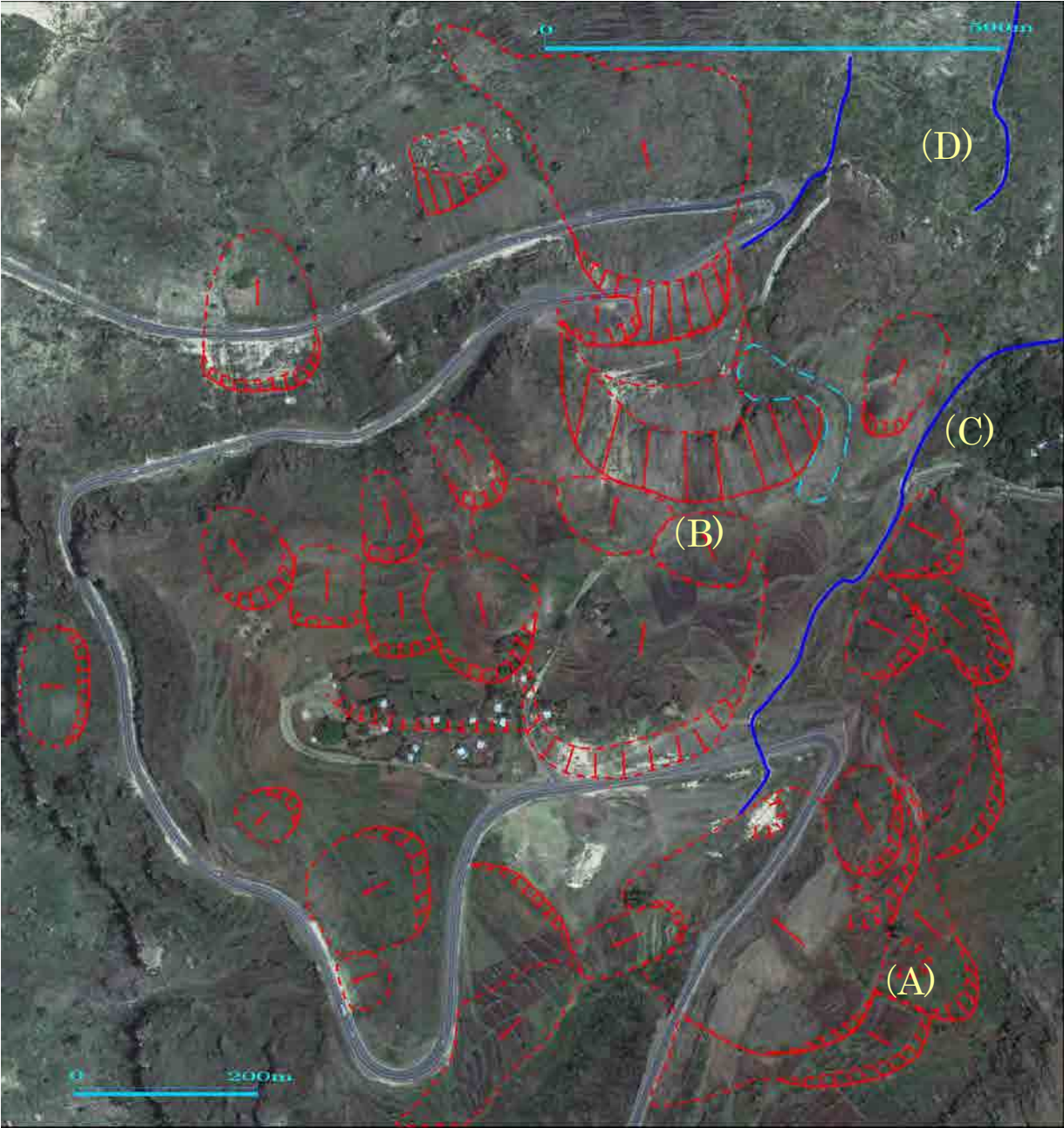


Figure 3.3.6 Satellite image interpretation ST.2+400 to ST.6+000

4) Vicinity of ST.5+500 to ST.8+400

Many landslides can be confirmed around (A), which are thought to be relatively old. (B) is an old large-scale landslide, however, it is considered to be stable. Three river systems are confirmed in this area (C, D and E).



Fig.3.3.7 Satellite image interpretation ST+5500 to ST+8400



5) Vicinity of ST.8+100 to ST.9+000

Landslides are confirmed at (A), however, they are all old. There is also evident dissection underway, and old landslides with vague crowns. These are not thought to have a direct or indirect impact on the road; therefore, they have not been interpreted. Six river systems (B to F) are confirmed in this area.



Fig.3.3.8 Satellite image interpretation ST.8+100 to ST.9+000

6) Vicinity of ST.8+900 to ST.9+500

The main river systems in this area are restricted by the ridge (A) with a northwesterly orientation, as such they flow in this direction. Several tributaries converge here. Dissection is underway here

There is also evident dissection, with several old landslides with vague crowns apparent along the river. There are no distinct landslides. There is a relatively large river system (B) into which two tributaries (C, D) flow.

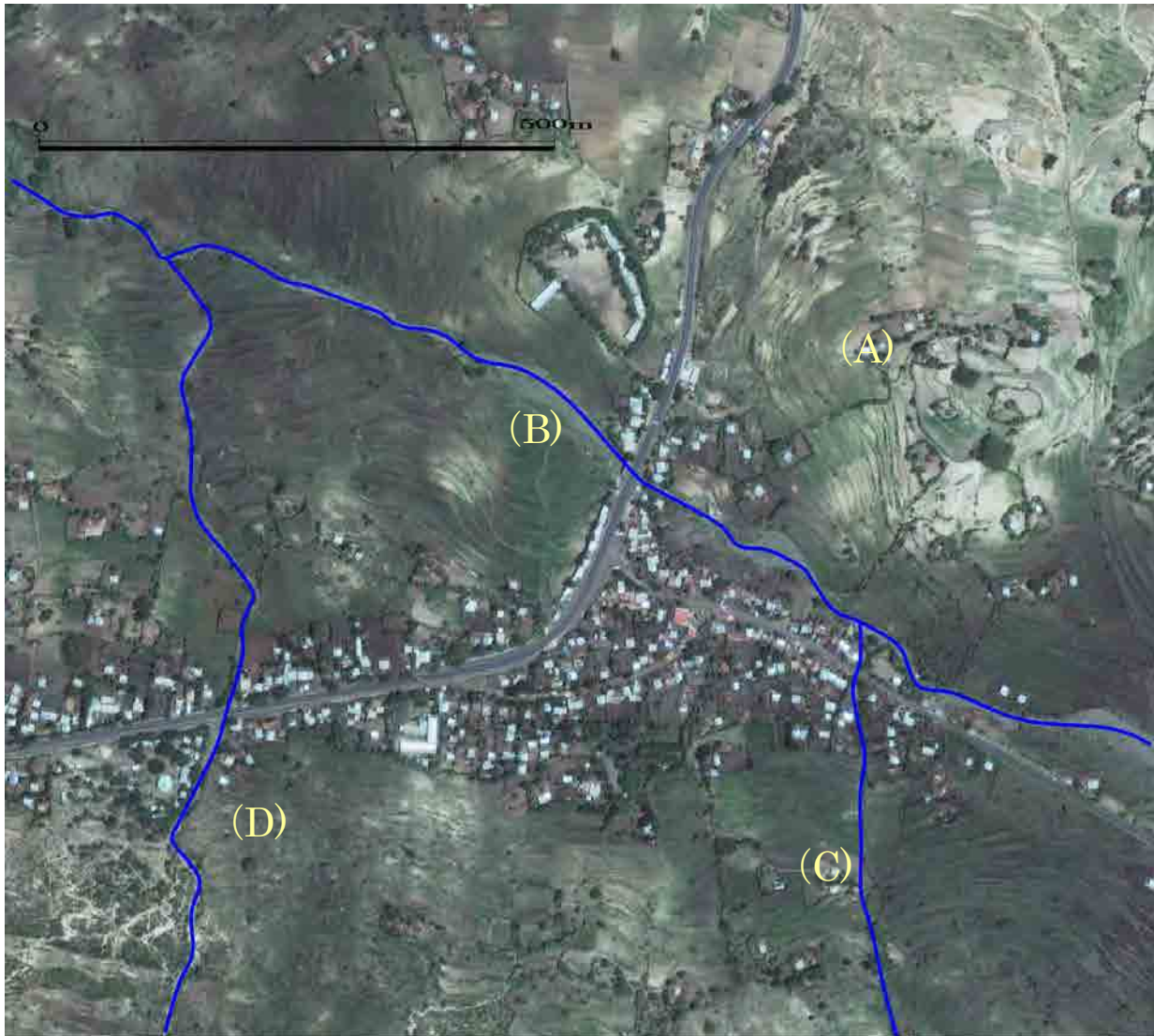


Fig.3.3.9 Satellite image interpretation ST.8+900 to ST.9+500



7) Vicinity of ST.9+200 to ST.10+400

There are several landslides below the main road; however, they are all old. Four river systems (A to D) are confirmed in this area.

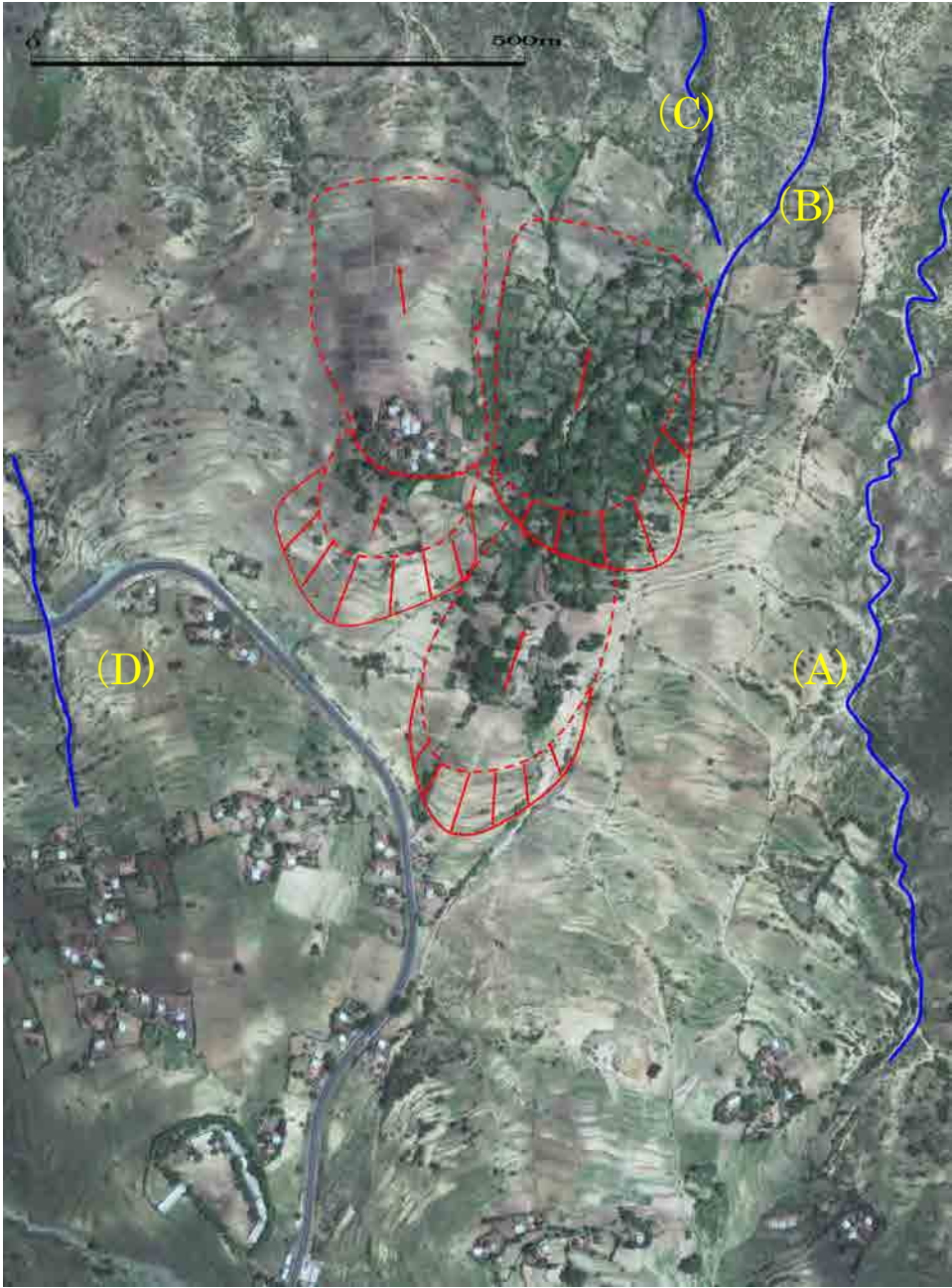


Fig.3.3.10 Satellite image interpretation ST.9+200 to ST10.400

8) Vicinity of ST.10+100 to ST.11+000

There are several relatively large landslides along the main road in this area. Of those, (A) is considered to be active, as steps are confirmed on either side of the road here. Three river systems, (B,D and D) are confirmed in this area.



Fig.3.3.11 Satellite image interpretation ST.10+100 to ST.11+000



9) Vicinity of ST.11+000 to ST.12+000

One landslide is confirmed to intersect the main road in this area. There are no other landslides affecting the road in this area. Three river systems, (A to C), are confirmed in this area.

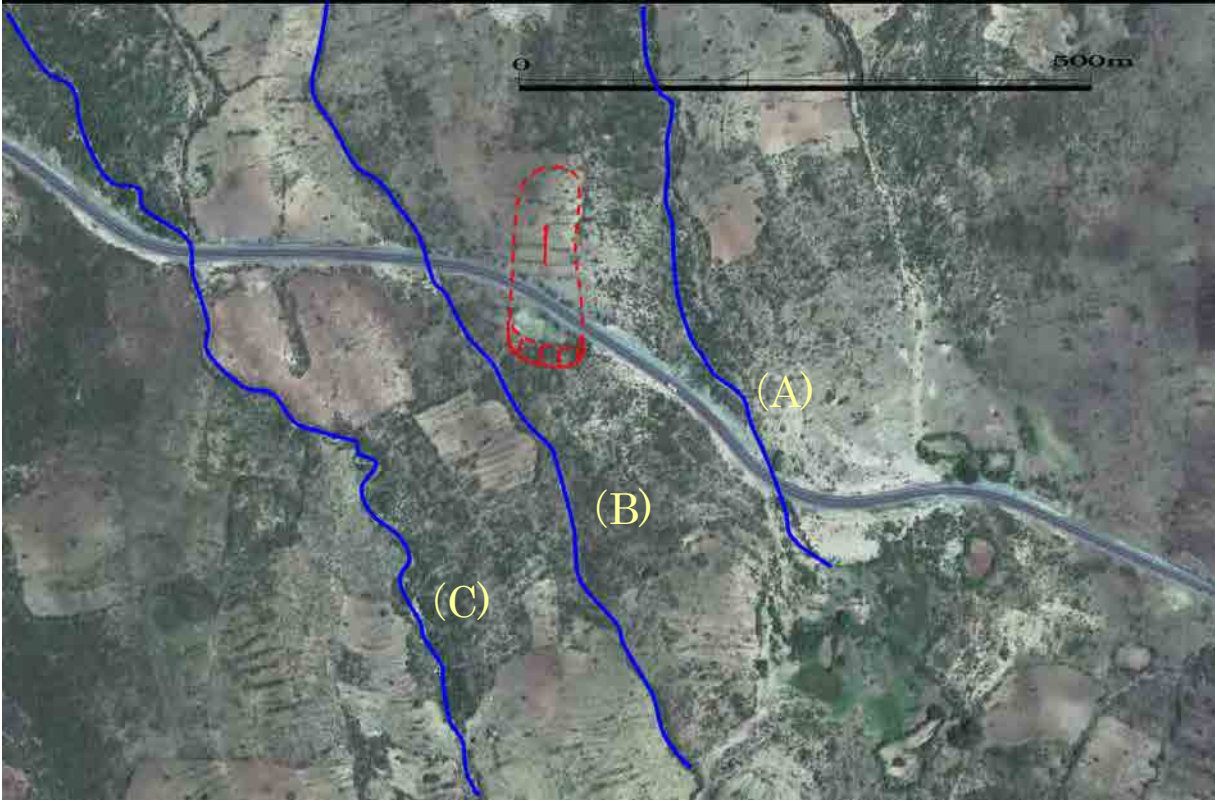


Fig.3.3.12 Satellite image interpretation ST.11+000 to ST12+000



10) Vicinity of ST.12+000 to ST.13+700

Several landslides (A) are confirmed in this area; however, these are secondary landslides that occurred in the debris of a larger landslide of the entire upper slope of a mountain. There are many river systems in this area, with six confirmed (B to G).

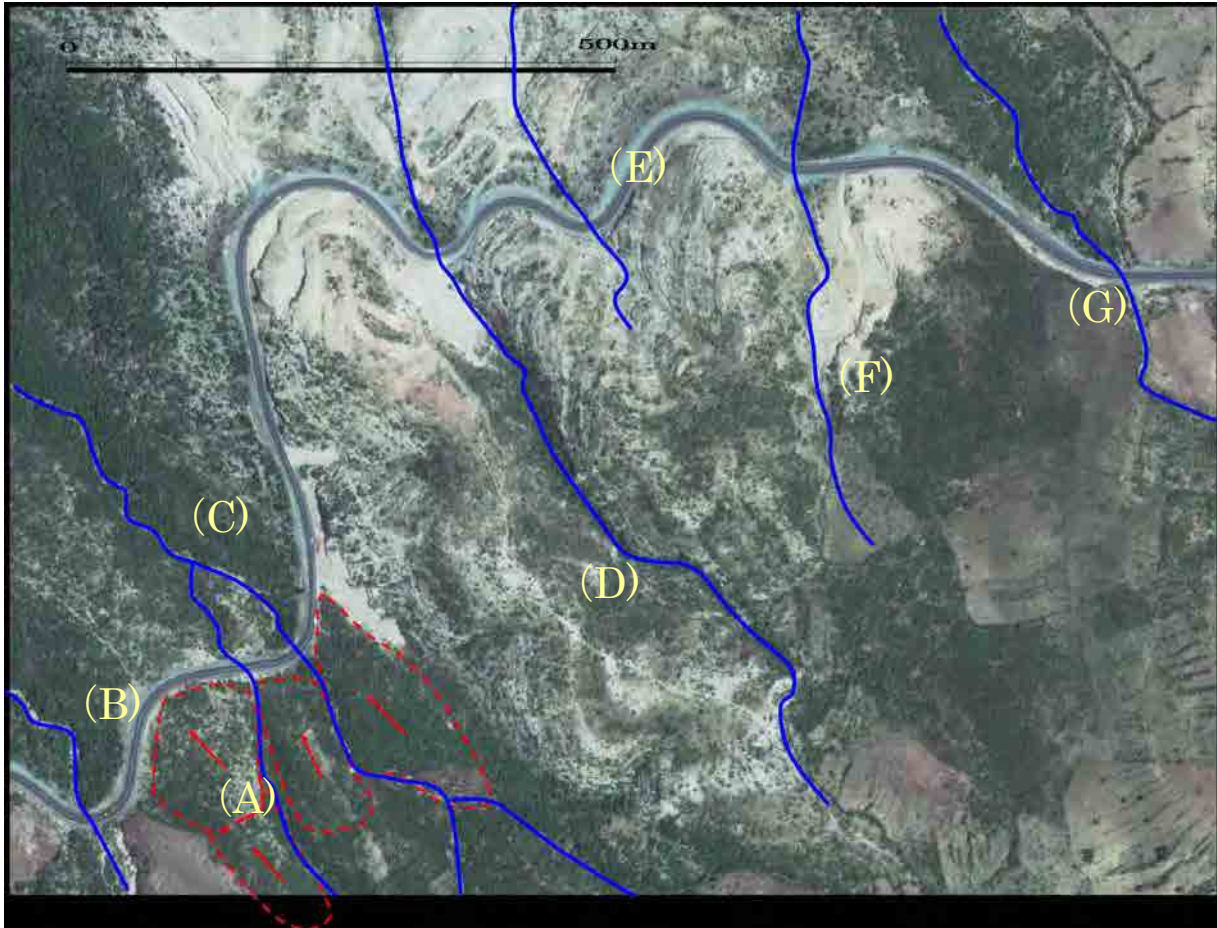


Fig.3.3.13 Satellite image interpretation ST.12+000 to ST.13+700

11) Vicinity of ST.14+200 to ST.15+100

Several landslides can be confirmed along the main road; however, all of them are old. As mentioned earlier, landslides in area (A) are secondary landslides that occurred in the debris of a large landslide encompassing an entire mountain slope. Two main river systems can be confirmed (B and C).

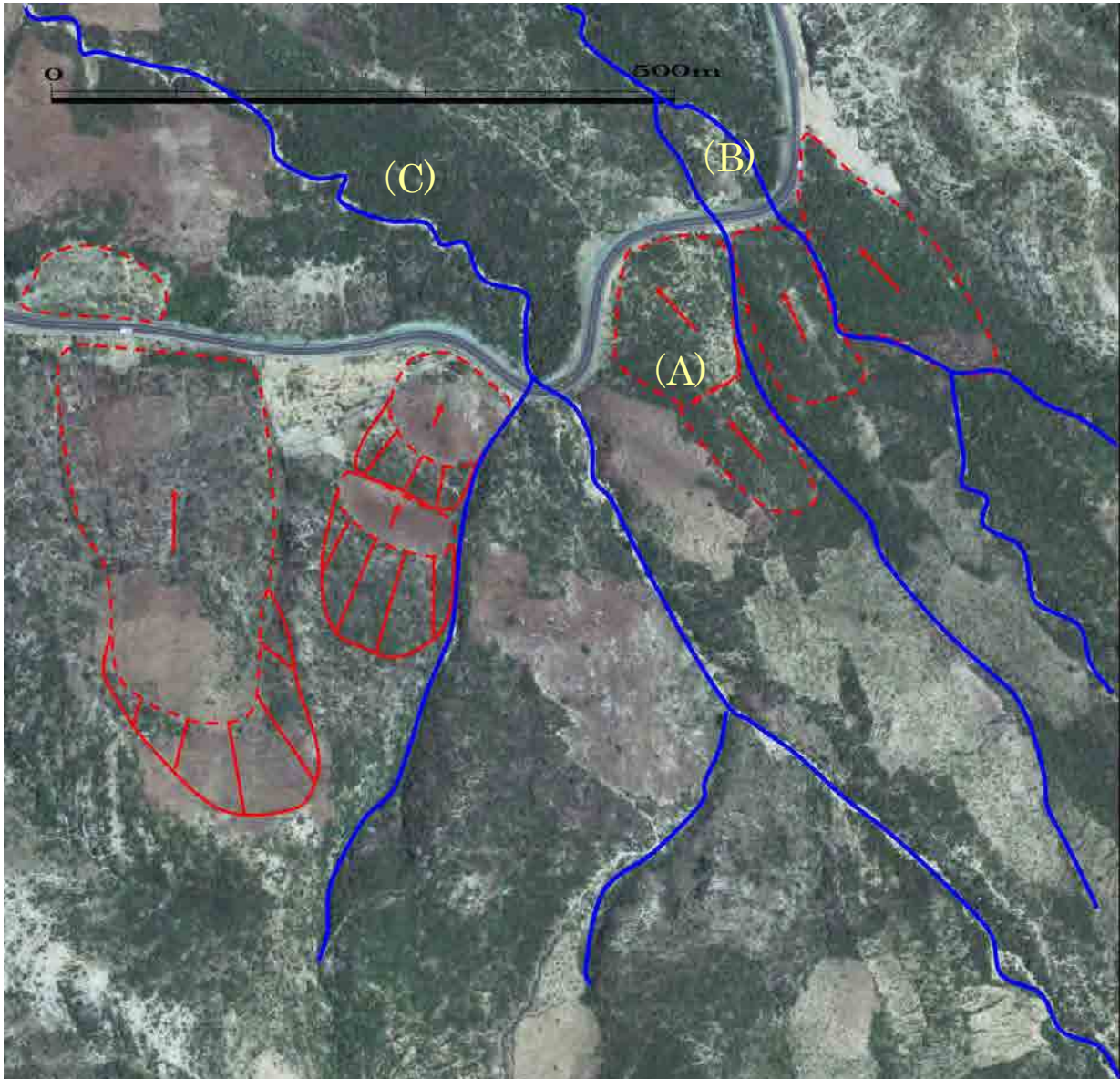


Fig.3.3.14 Satellite image interpretation ST+14200 to ST+15100



12) Vicinity of ST.14+600 to ST.15+800

Several landslides are confirmed along the main road in this area, all of which are old. There is a small slope failure on the valley side of the road (A). There are three river system divisions (B,C and D) in this area.

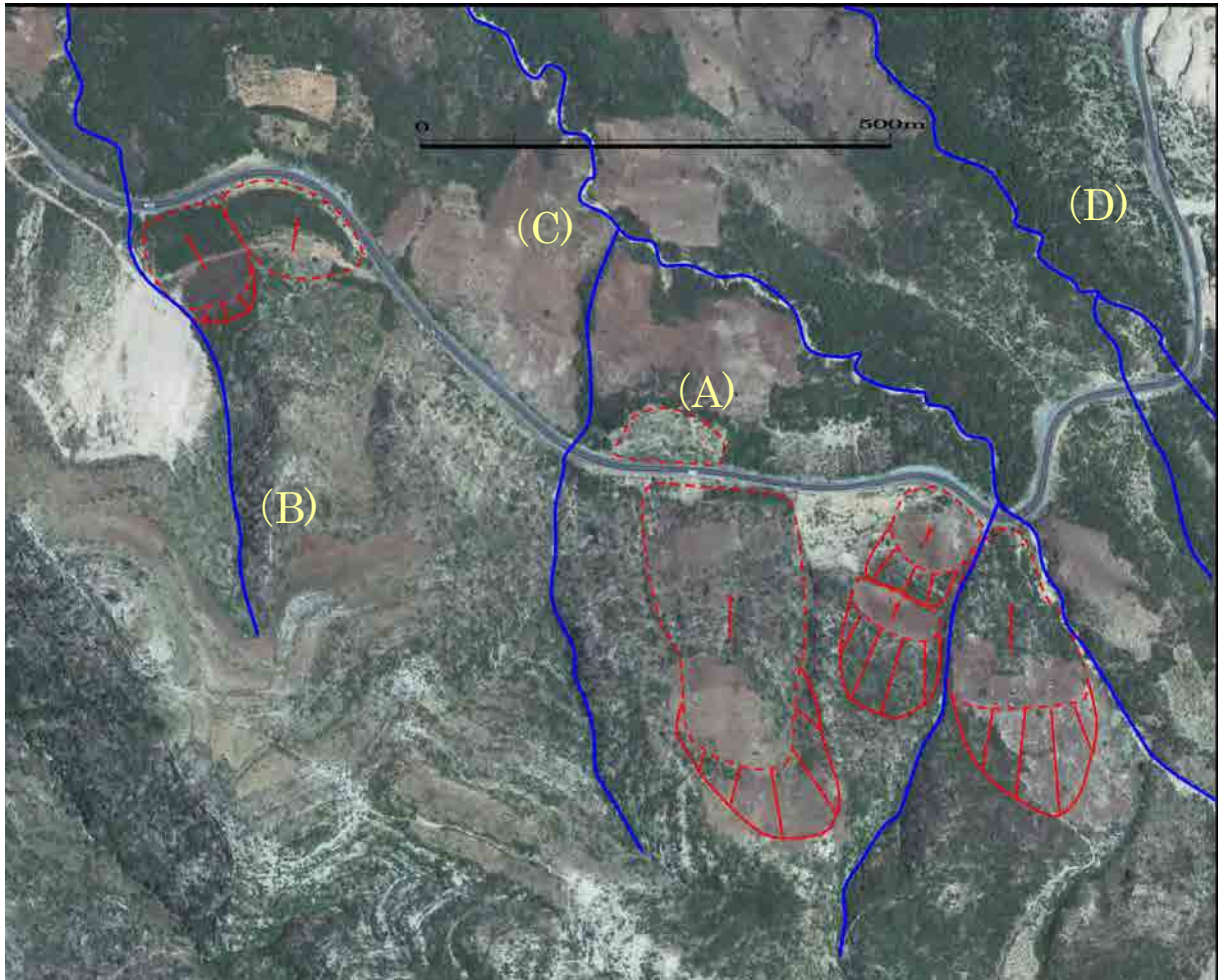


Fig.3.3.15 Satellite image interpretation ST+14600 to ST+15800



13) Vicinity of ST. 15+600 to ST.16+800

Several landslides are confirmed along the main road in this area, all of which are old. There are three main river systems (A to C) in this area.

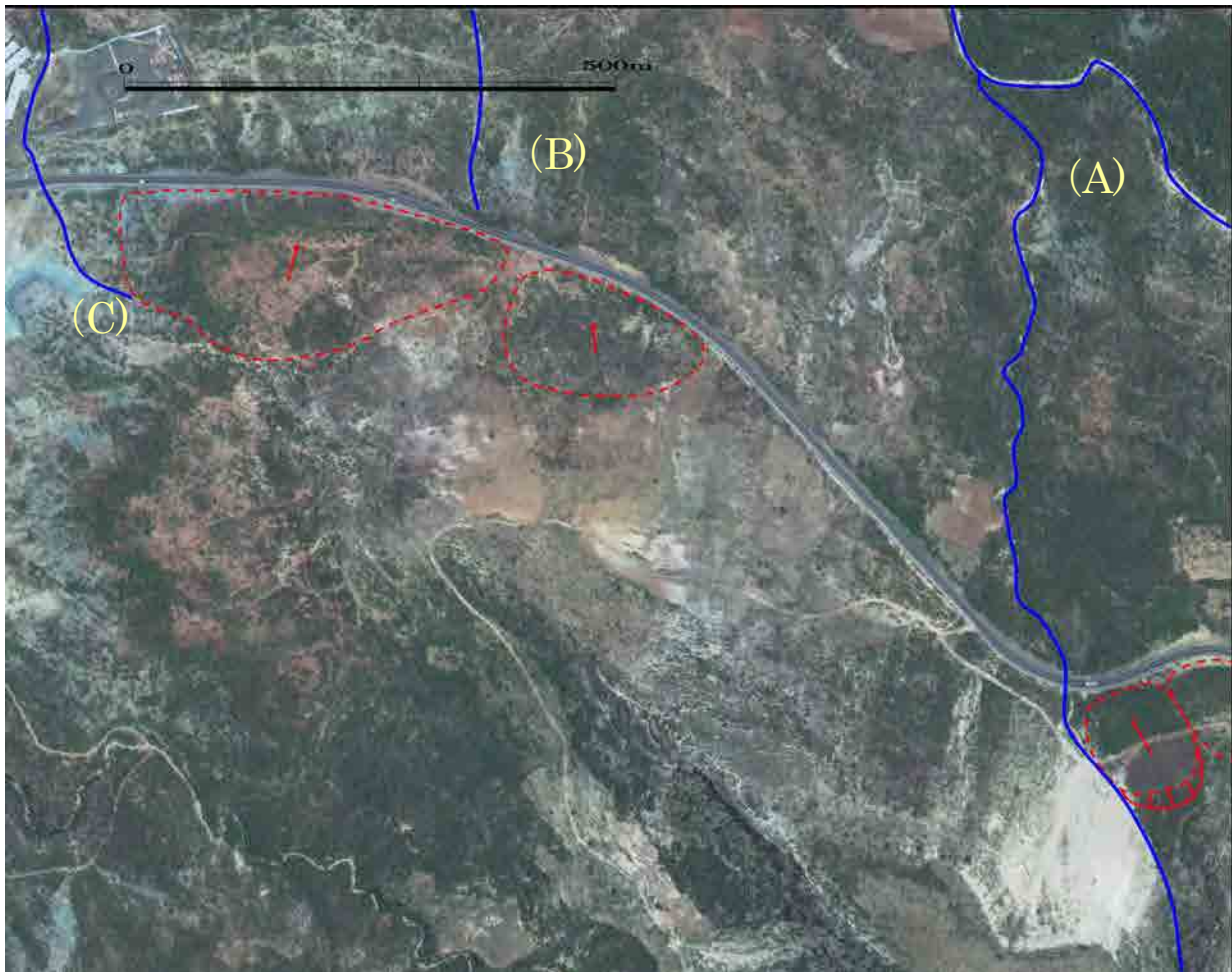


Fig.3.3.16 Satellite image interpretation ST.15+600 to ST.16+800

14) Vicinity of ST.17+000 to ST.18+000

No landslides can be confirmed along the main road. In this area, two tributaries (B, C) flow into river system (A), while (D) is a separate system.



Fig.3.3.17 Satellite image interpretation ST.17+000 to ST.18+000

15) Vicinity of ST.17+700 to ST.21+000

Several small landslides/slope failures are scattered along the main road. Two tributaries (A and B) are confirmed flowing into the Blue Nile in this area.



Fig.3.3.18 Satellite image interpretation ST.17+700 to ST.21+000



16) Vicinity of ST.21+000 to ST.22+000

Small landslides are scattered along the main road in this area. Small deformations are thought to have occurred in recent years due to the presence of steps and cracks. Three tributaries (B to D) are confirmed for the river system (A).



Fig.3.3.19 Satellite image interpretation ST+21000 to ST+22000

17) Vicinity of ST.21+700 to ST.22+600

Small landslides are scattered along the main road in this area. Small deformations are thought to have occurred in recent years due to the presence of steps and cracks at (A) and (B). Four tributaries (D to G) are confirmed for the river system (C).

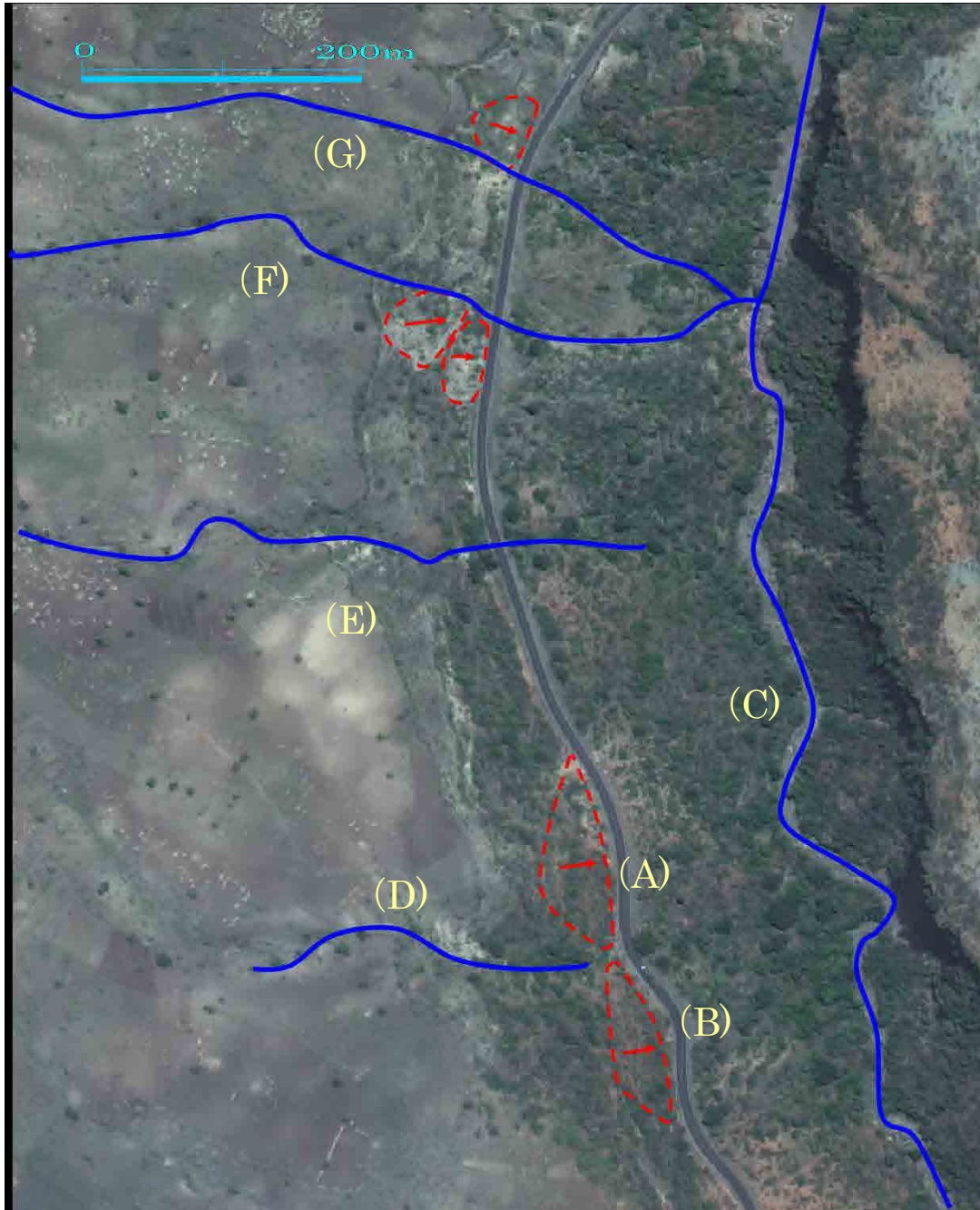


Fig.3.3.20 Satellite image interpretation ST+21700 to ST+22600

18) Vicinity of ST.22+200 to ST.24+700

Small landslides are scattered along the main road in this area. Movements are thought to be continuing recently due to the presence of new cracks in the main scarp at points A and B. Three tributaries (D to F) are confirmed for the river system (C).

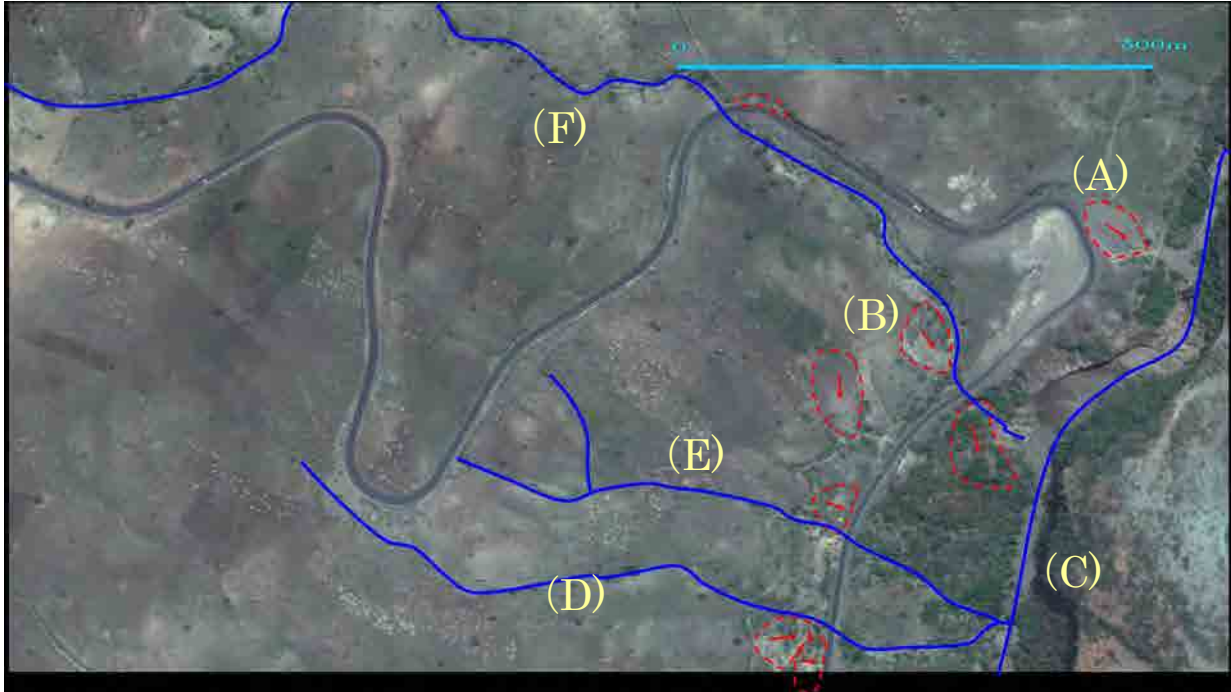


Fig.3.3.21 Satellite image interpretation ST.22+200 to ST.24+700



19) Vicinity of ST.25+700 to ST.26+200

Dissection is apparent in this entire area. There are no pronounced landslides. A large river system, (A), flows along the main road.

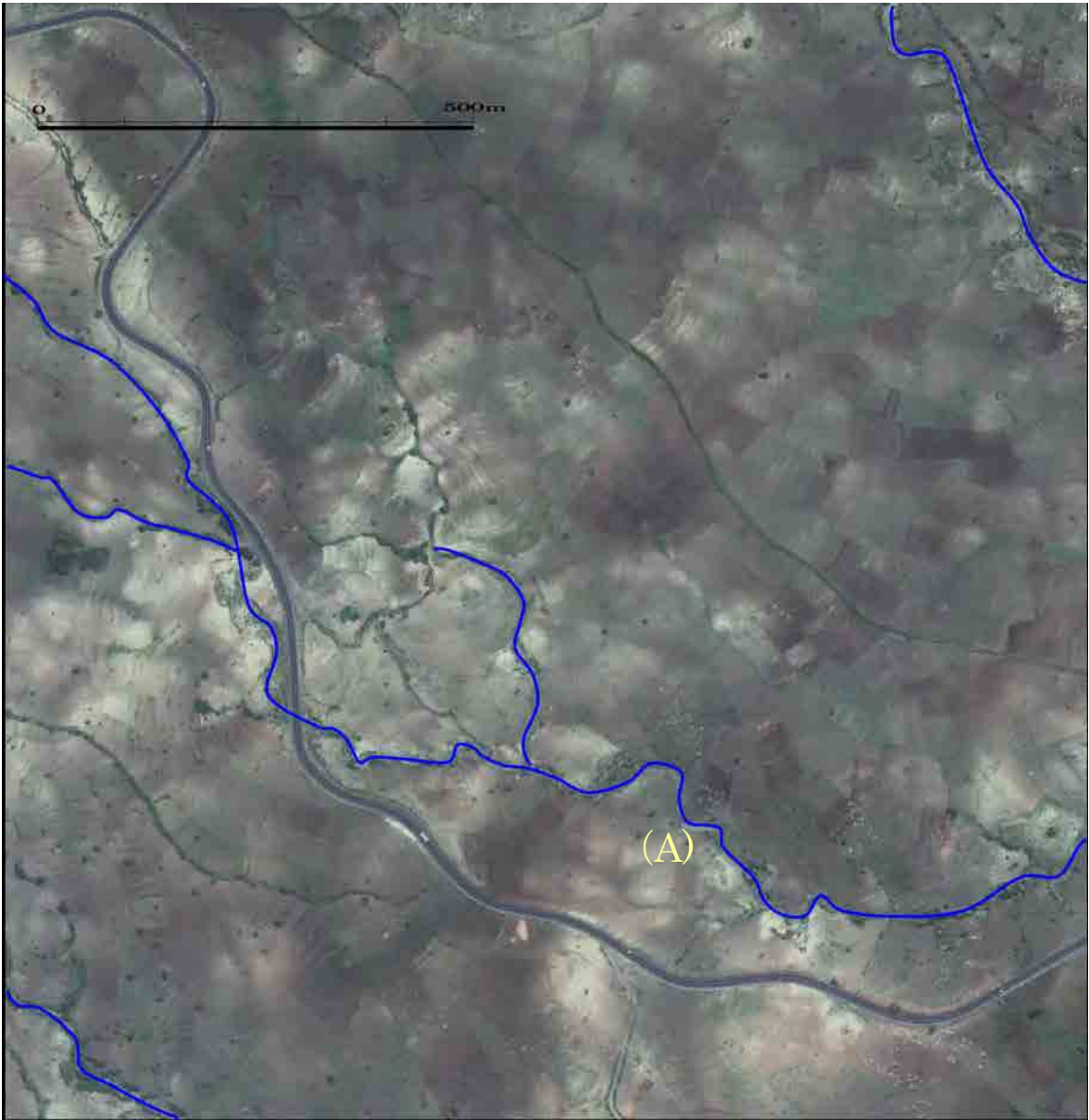


Fig.3.3.22 Satellite image interpretation ST.25+700 to ST.26+200

20) Vicinity of ST.26+000 to ST.27+200

Dissection is apparent in this entire area. There are no pronounced landslides. Several river systems (A to D) flow in the same general direction as the main road.

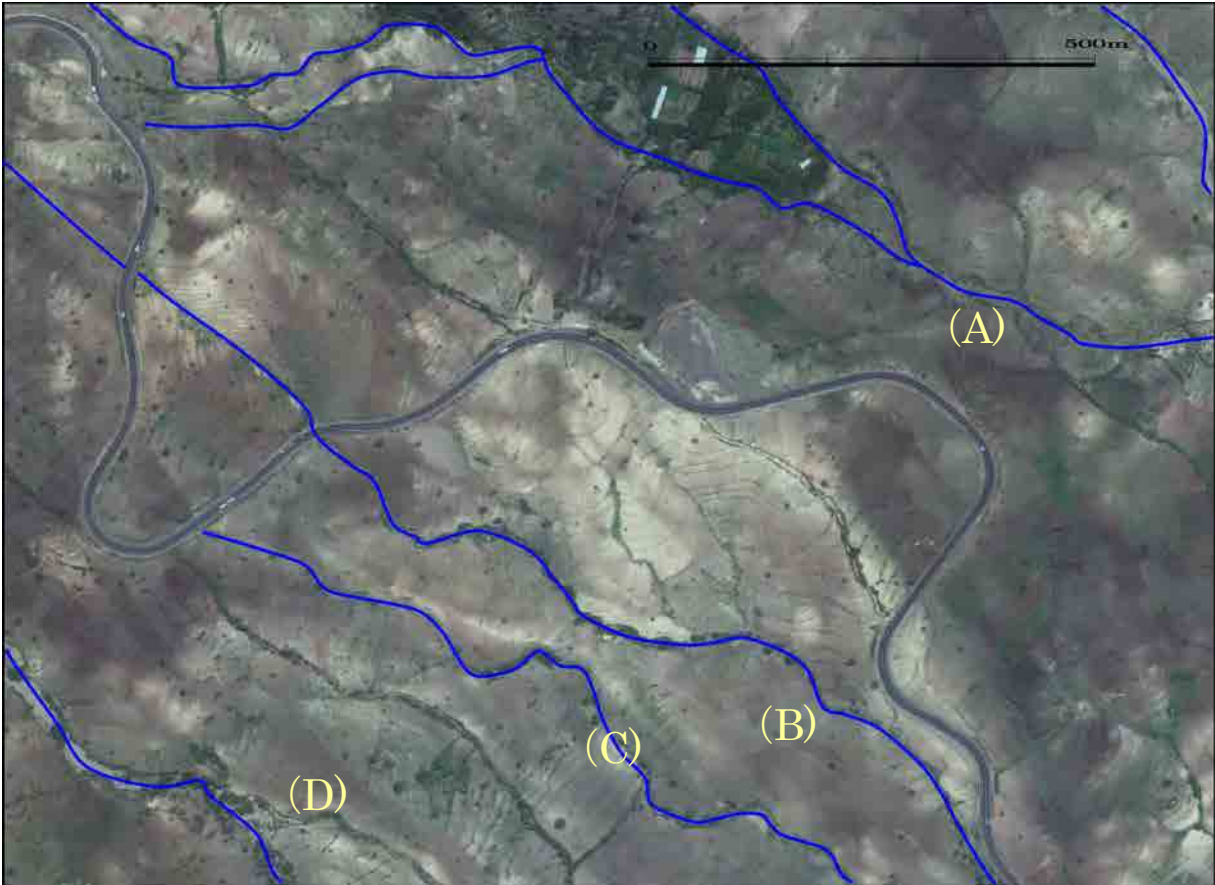


Fig.3.3.23 Satellite image interpretation ST.26+000 to ST.27+200

21) Vicinity of ST.27+000 to ST.28+800

There are many landslides from small one to large one in this area. Many of these continue to be active as they have new main scarps and cracks. There is a man-made waterway (A), and several river systems surrounding the landslides (B, C, D).

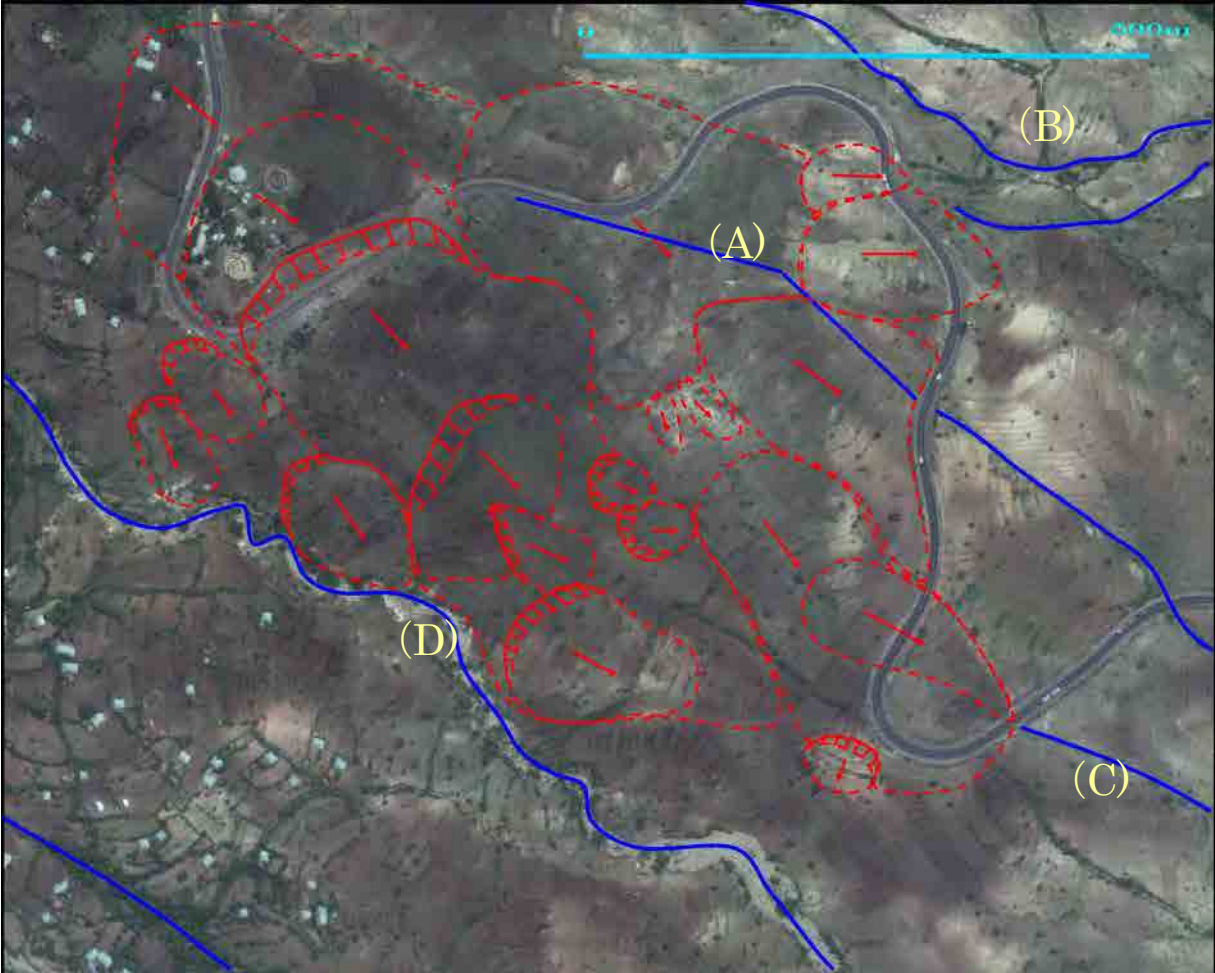


Fig.3.3.24 Satellite image interpretation ST.27+000 to ST.28+800



22) Vicinity of ST.28+200 to ST.29+700

There are many landslides in this area. Amongst the larger landslides there are overlapping secondary-landslides, many of which continue to be active. There are also many new landslides with main scarps. There are large river systems (A and B) surrounding the landslides, while amongst them, there are only a few systems.



Fig.3.3.25 Satellite image interpretation ST.28+200 to ST.29+700

23) Vicinity of ST.30+300 to ST.31+500

A large, old landslide is confirmed within this area. Two river systems (A and B) can be confirmed, one on either side of this landslide.

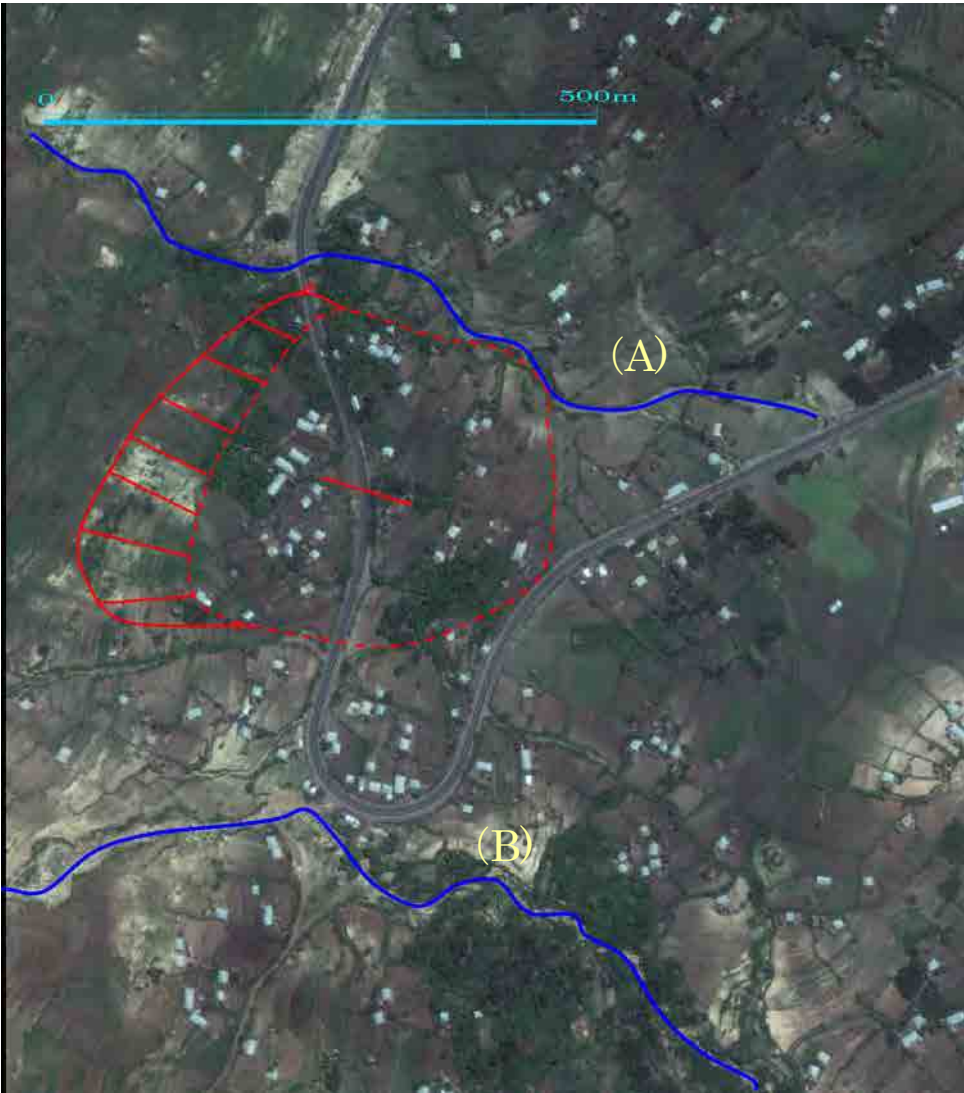


Fig.3.3.26 Satellite image interpretation ST.30+300 to ST.31+500

24) Vicinity of ST.31+400 to ST.33+000

This entire area is within one old and extremely large landslide. There is a series of secondary landslides on the mountain side of the main road. The slope deformation can be considered to be active, because the slope on the mountain side of the road is being pushed out. One active landslide (A), while small, is causing deformation in the main road.

There are steps, B and C, confirmed in the road; however, they are not connected to any landslides. These are presumed to be the result of factors other than landslides such as sediment runoff around an old box culvert or a lack of strength in the road embankment materials. The river systems, D to I, occur mostly in parallel to the slope direction.

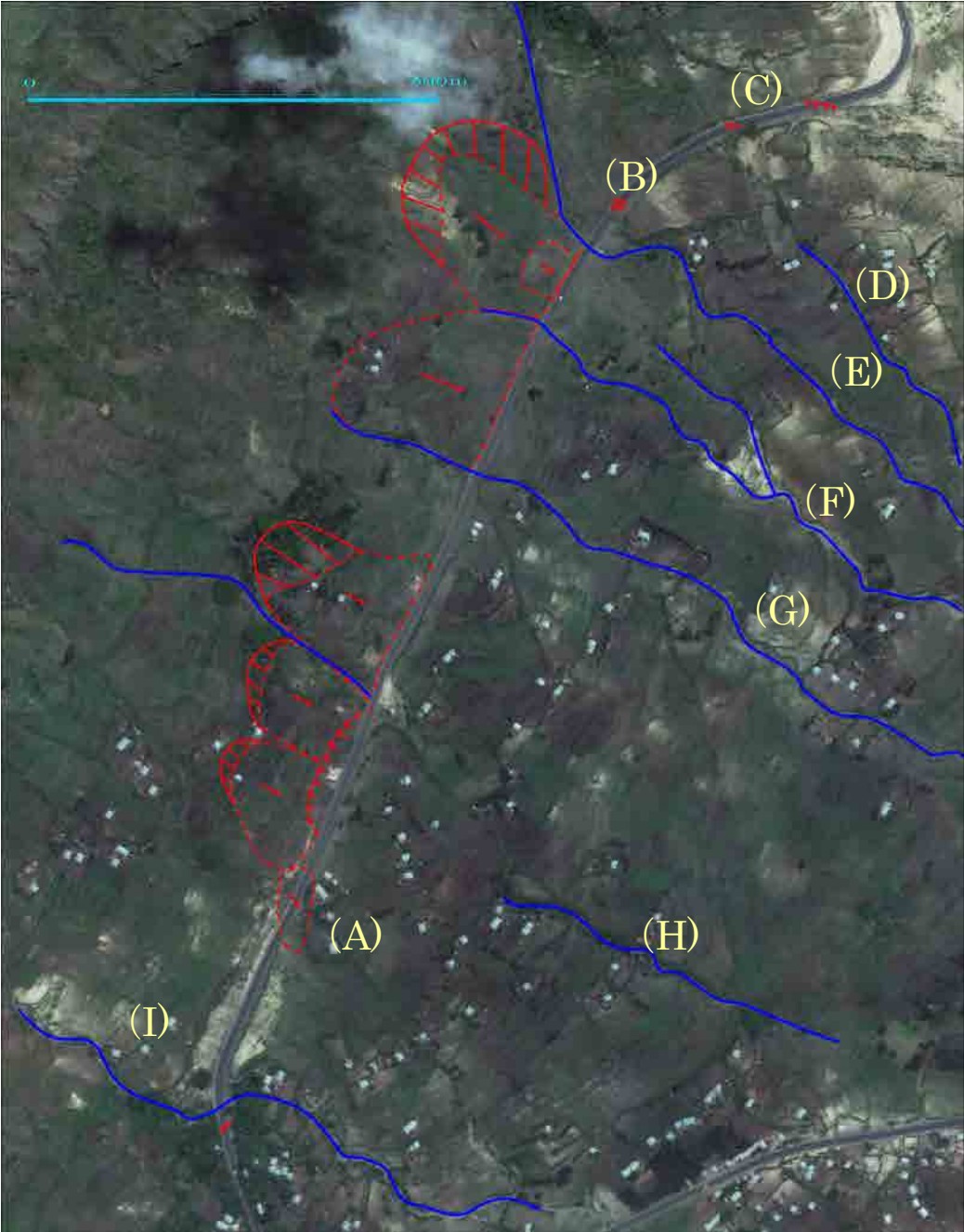


Fig.3.3.27 Satellite image interpretation ST.31+400 to ST.33+000



25) Vicinity of ST.32+200 to ST.33+900

No landslides can be confirmed to be connected to the series of steps in the road at A and B in this area. As aforementioned, these steps are thought to be a result of an unrelated factor such as weak embankment materials. The small landslide, C, is thought to be a newly active slip because of the depression it has caused in the road. There is also a slope failure (D) on the valley side of the road.

The river systems in this area, E to J, occur mostly in parallel to the main slope direction.

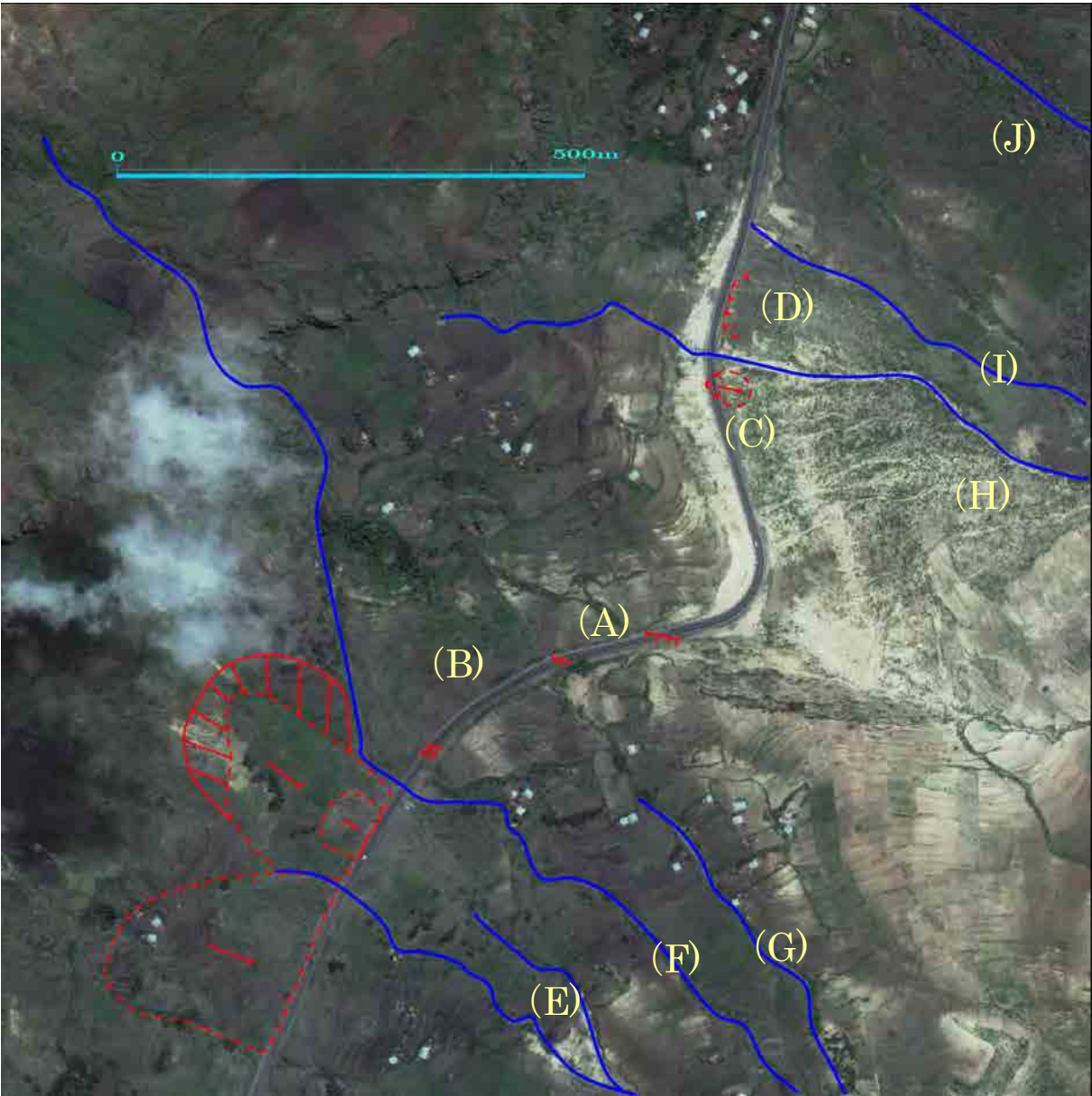


Fig.3.3.28 Satellite image interpretation ST.32+200 to ST.33+900

26) Vicinity of ST.33+600 to ST.34+300

There is only one old landslide confirmed in this area. The river systems flow in parallel to the main slope direction, most notably A, flowing from Dejen Town, and also B and C.



Fig.3.3.29 Satellite image interpretation ST.33+600 to ST.34+300

27) Vicinity of ST.34+300 to ST.37+300

This area has a variety of large to small landslides along the main road, however, most are old. Of these, A is thought to have started moving in the last few years because it is confirmed to be pushing out the road. Several river systems are confirmed in this area (B, C and D).

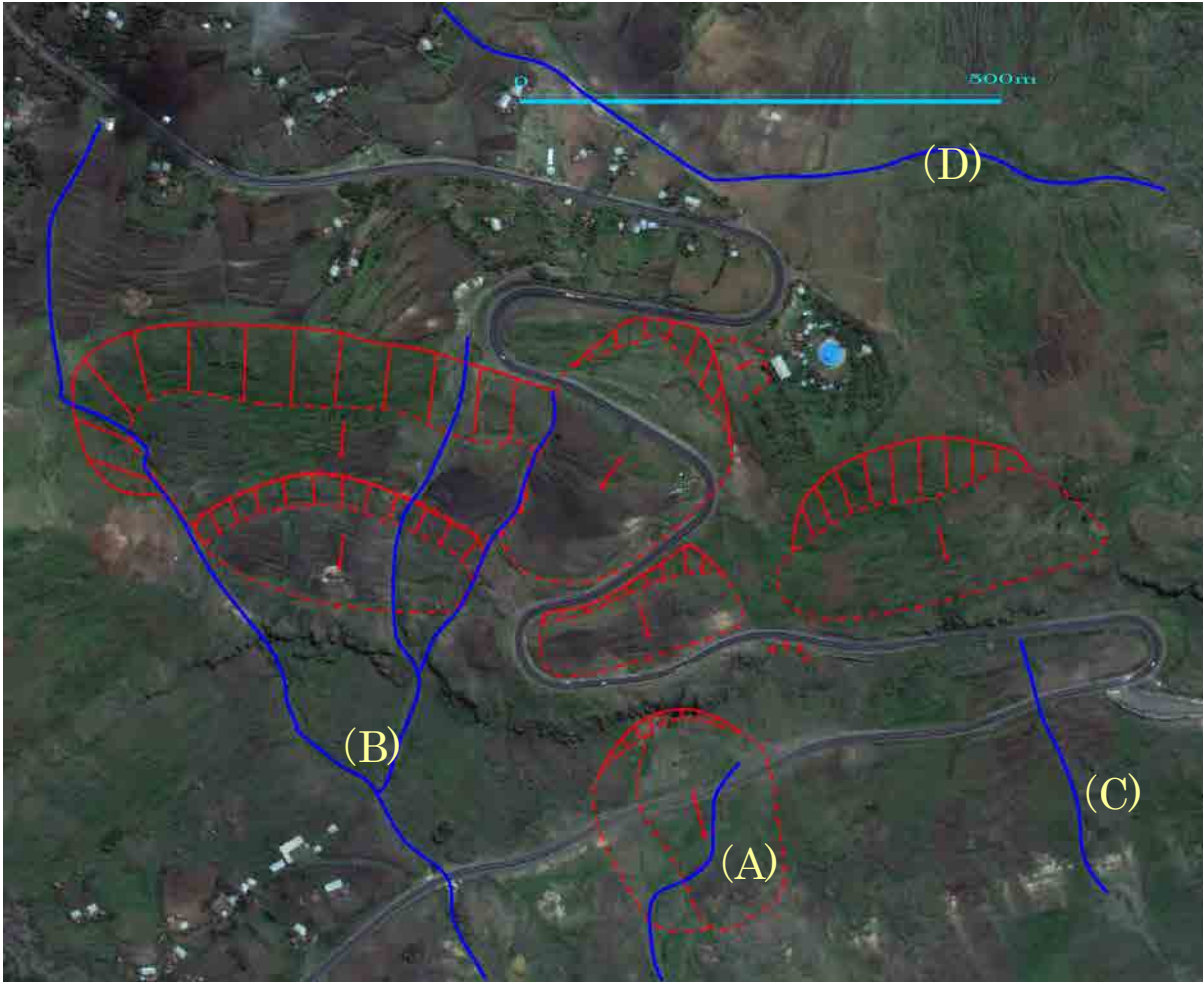


Fig.3.3.30 Satellite image interpretation ST.34+300 to ST.37+300

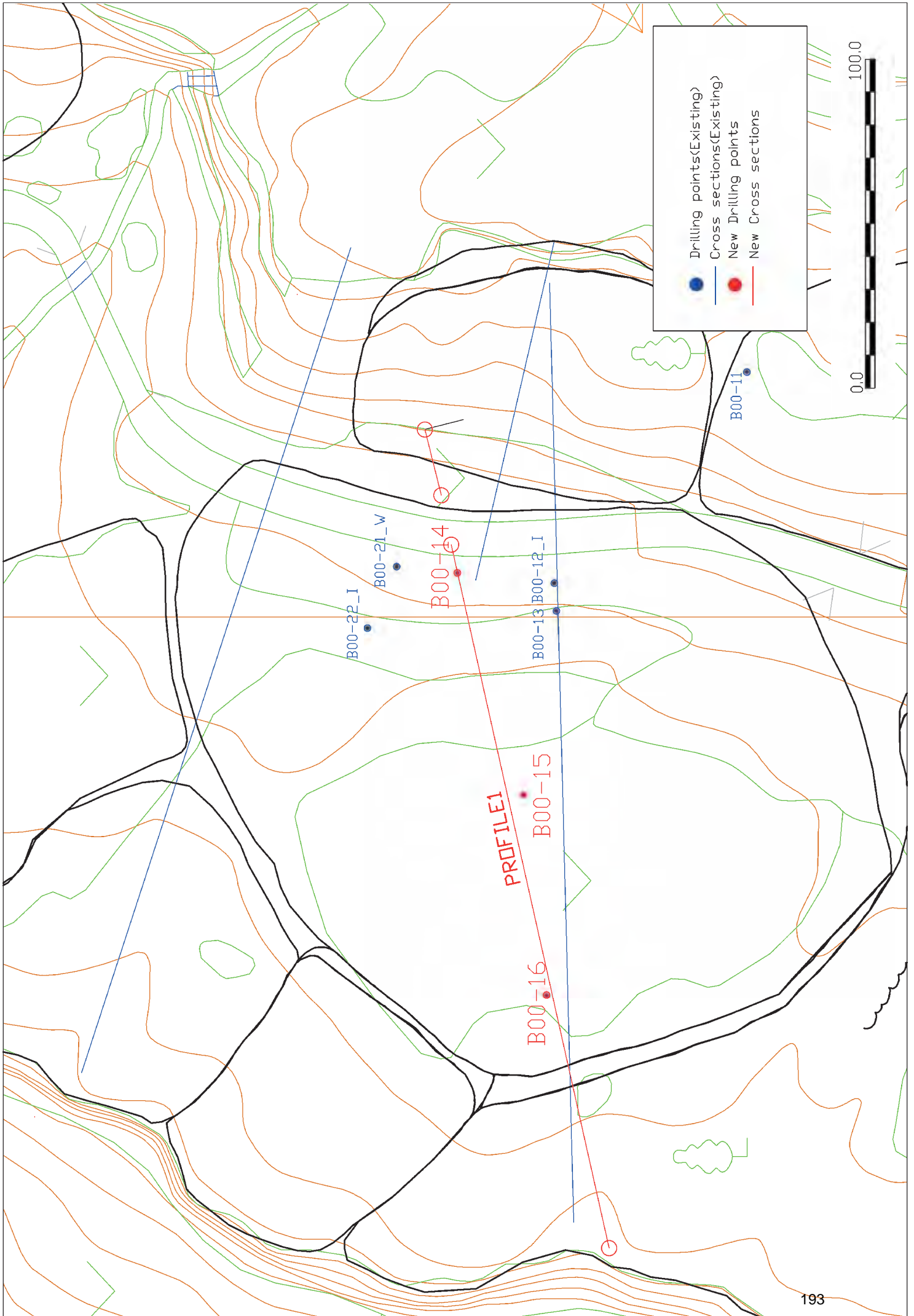


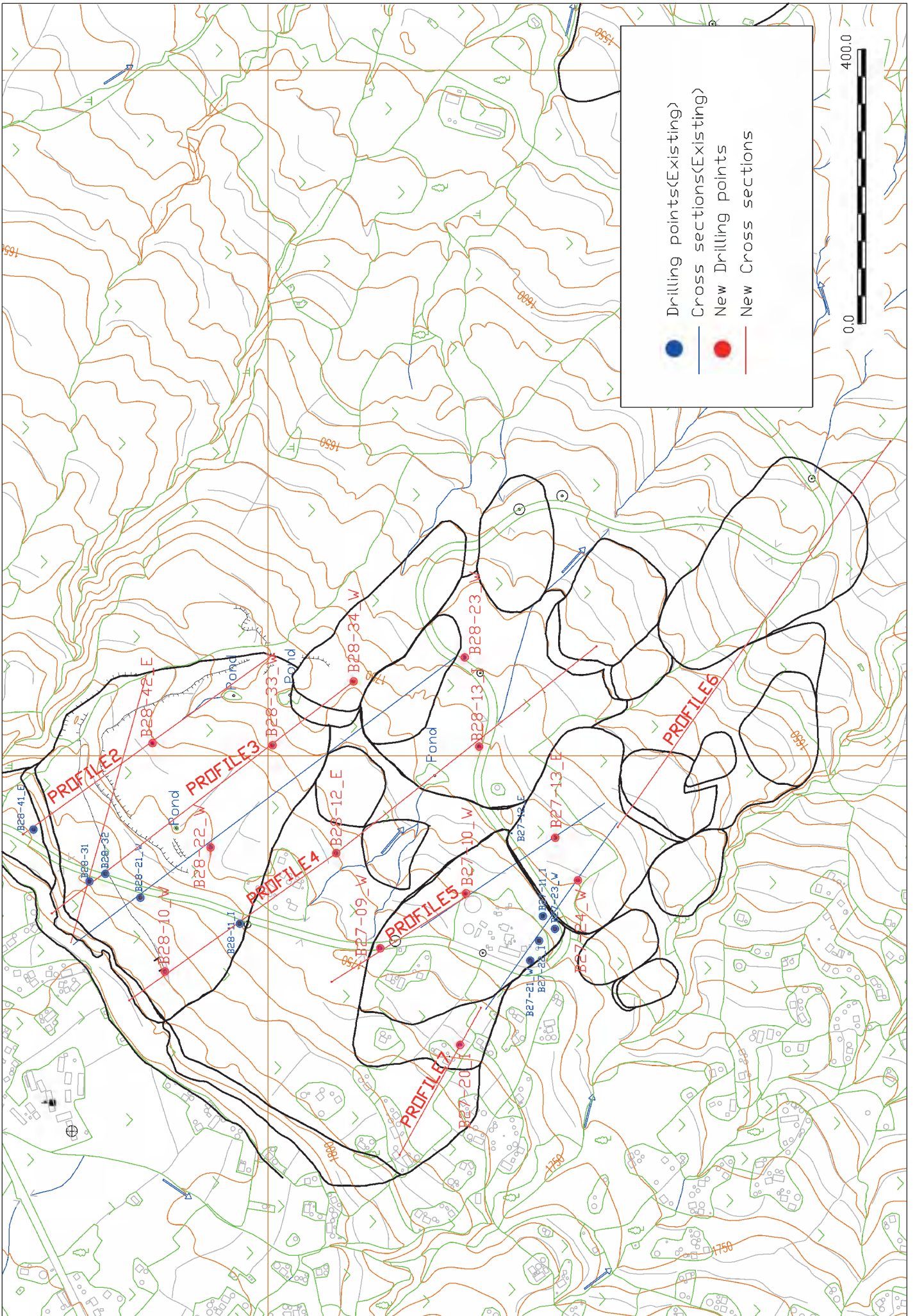


9. Geophysical exploration and profile





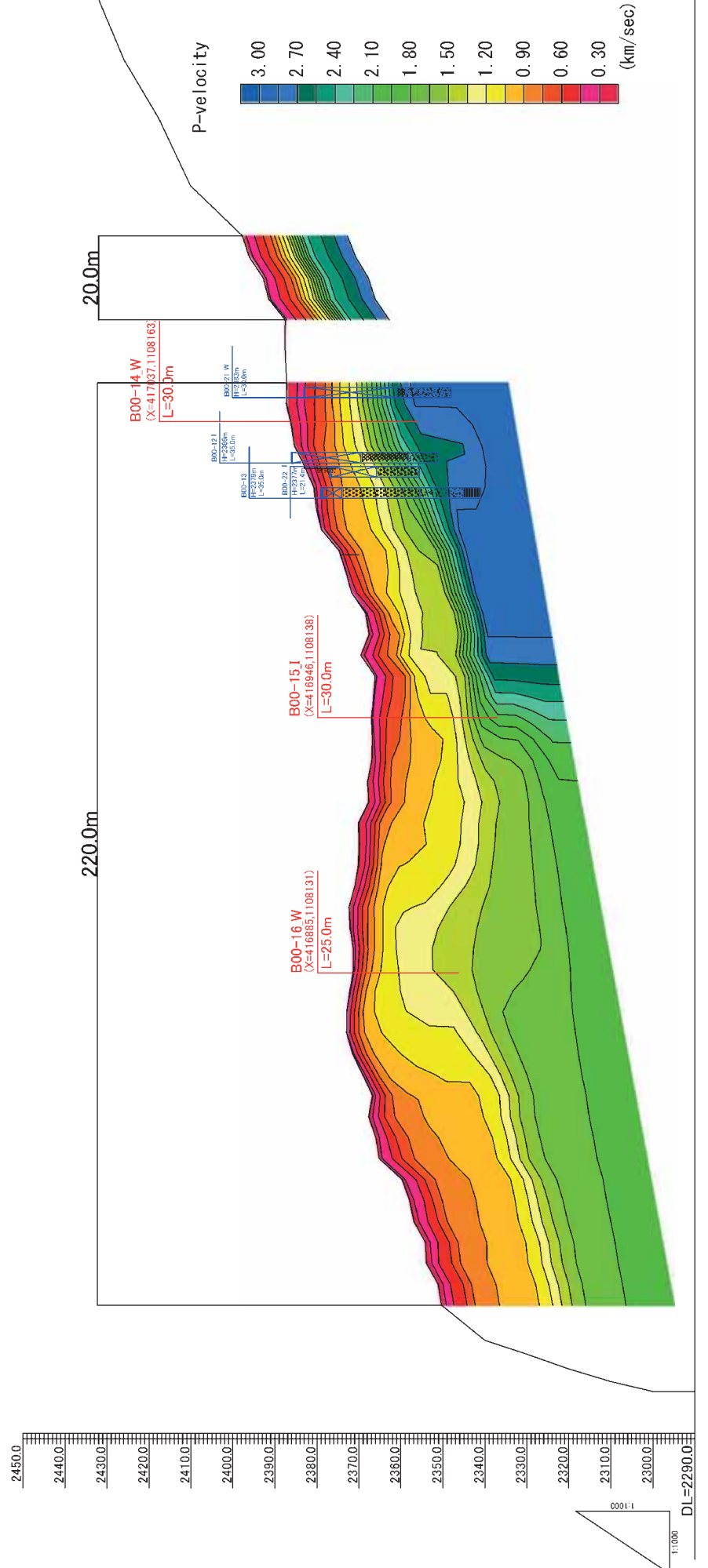




<span style="color: blue;">●</span>	Drilling points<Existing>
<span style="color: blue;">—</span>	Cross sections<Existing>
<span style="color: red;">●</span>	New Drilling points
<span style="color: red;">—</span>	New Cross sections

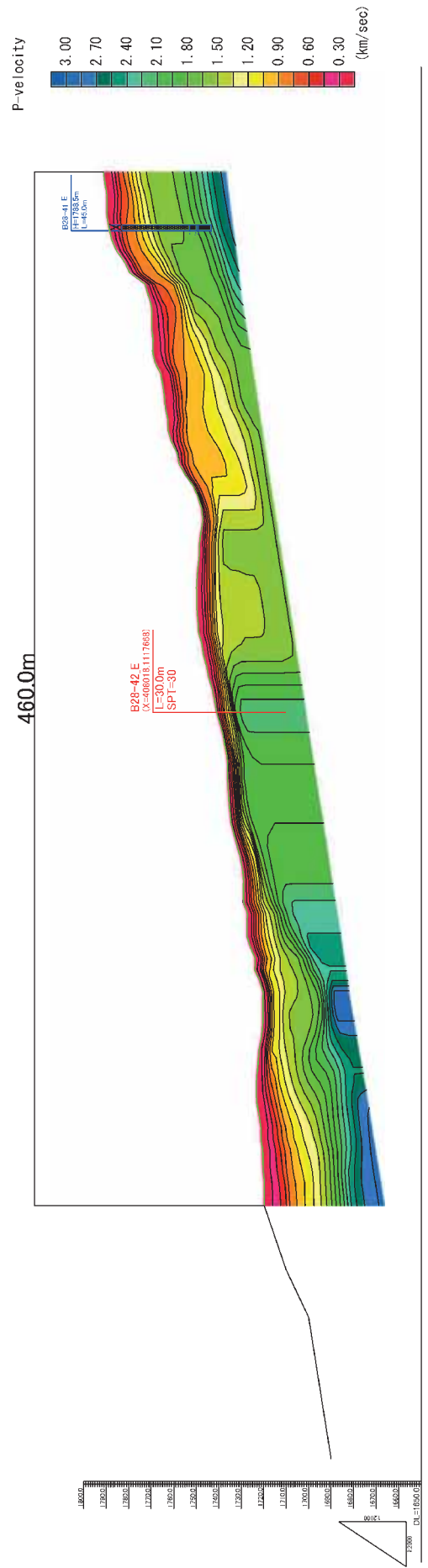


# Geo seismic section of profile 1 (L/S00) Scale 1 : 1000

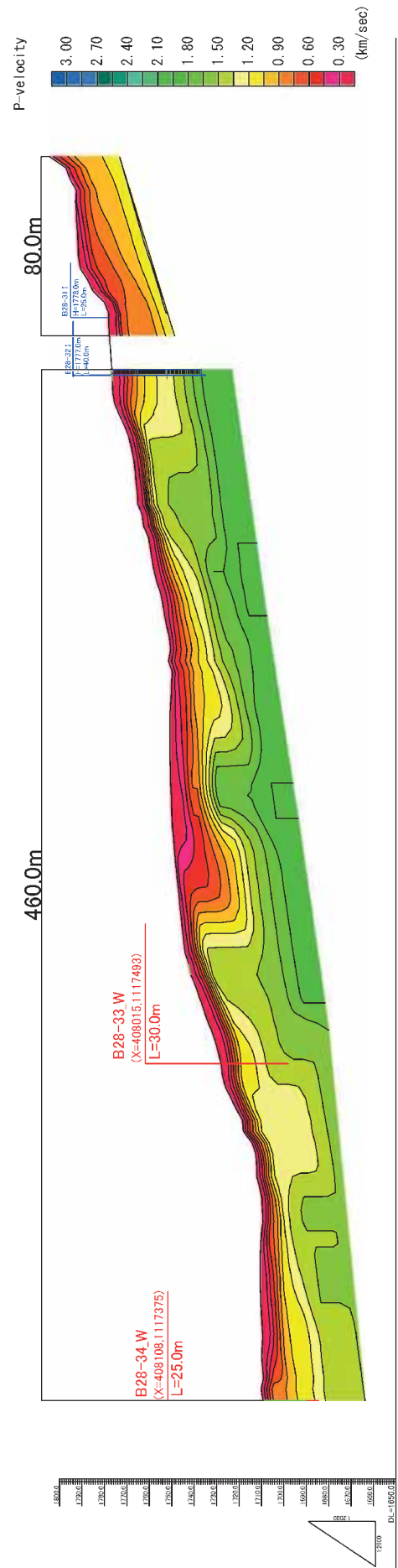




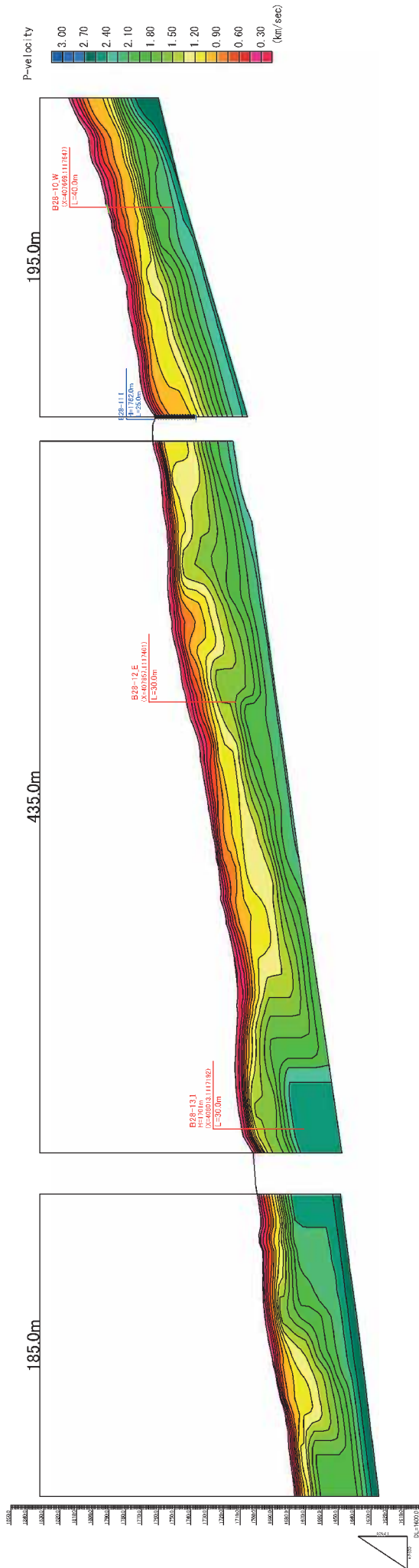
# Geo seismic section of profile 2 (L/S28) Scale 1 : 2000



# Geo seismic section of profile 3 (L/S28) Scale 1 : 2000

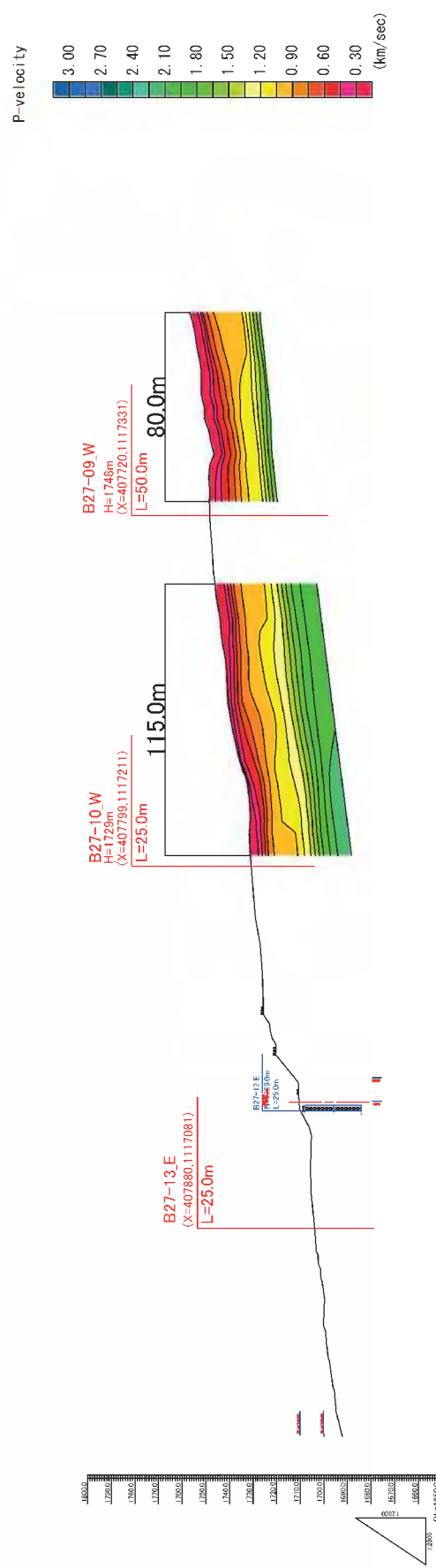


# Geo seismic section of profile 4 (L/S28) Scale 1 : 2500



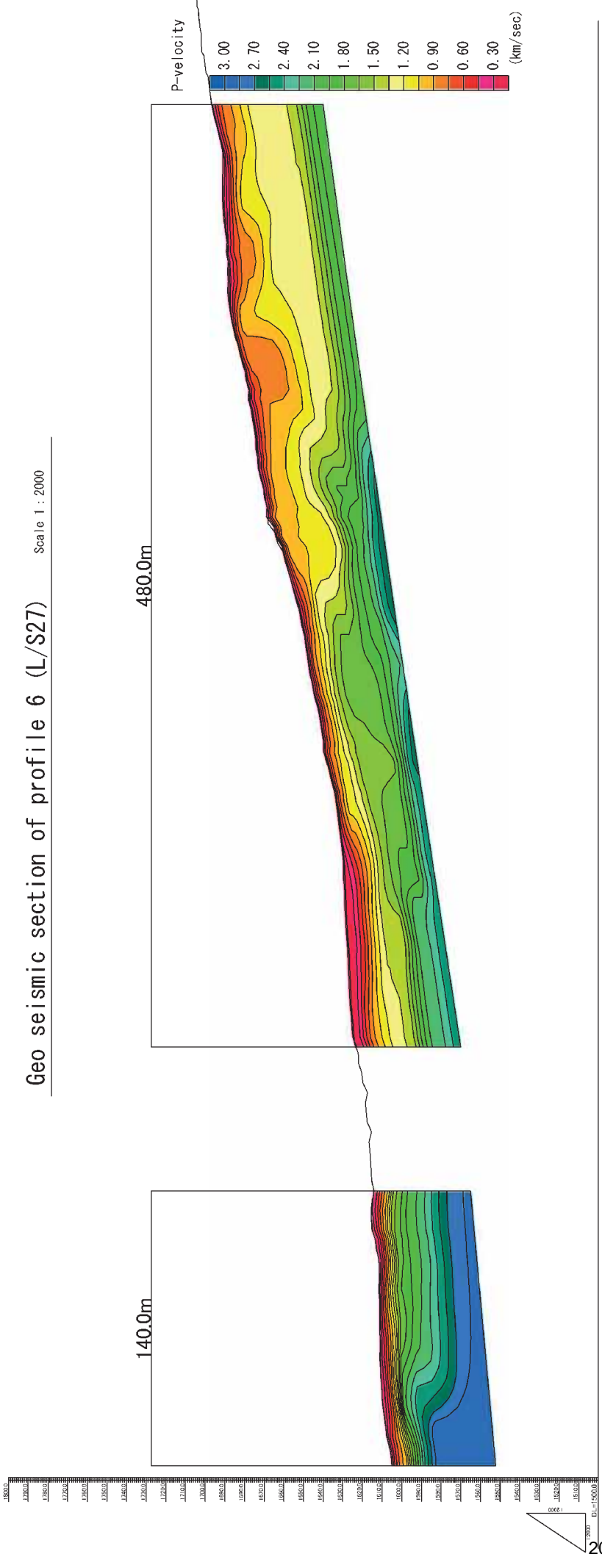


# Geo seismic section of profile 5 (L/S27) Scale 1 : 2000



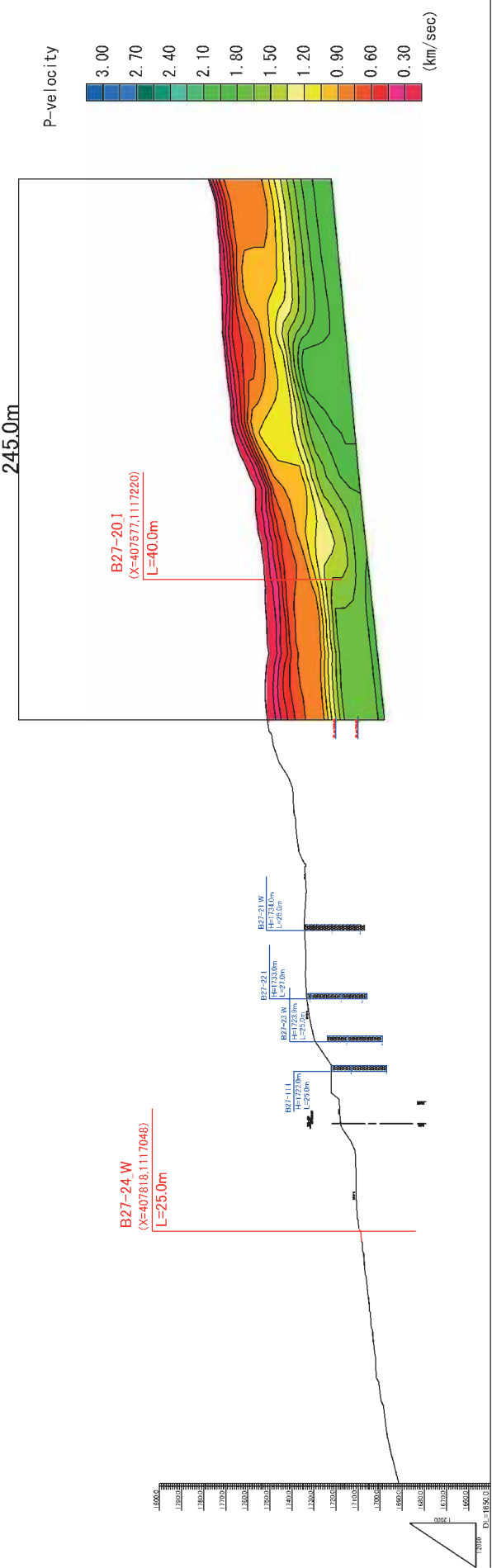
# Geo seismic section of profile 6 (L/S27)

Scale 1 : 2000



# Geo seismic section of profile 7 (L/S27)

Scale 1 : 2000





### 3.6 Geophysical Exploration

#### (1) Results of Seismic Exploration

##### (i) L/S: Traverse line BO-01

Illustrated below is a travel-time curve generated based on the values recorded along the traverse line BO-01 (Fig 1). Fig 2 is an analytical diagram of velocity profile for the same line.

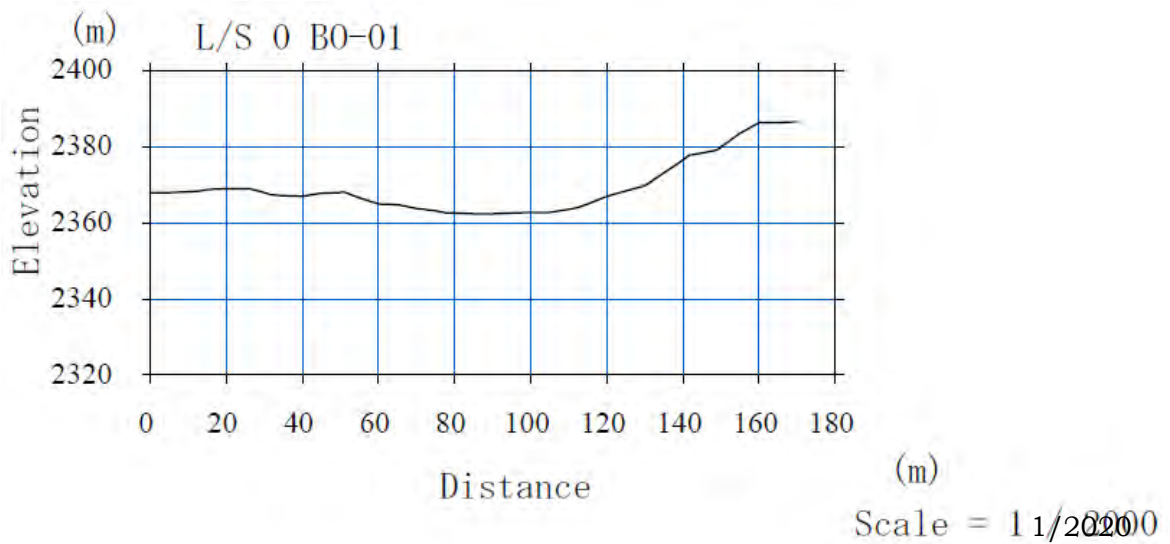


Fig 1. Section of L/S 0: Traverse line BO-01

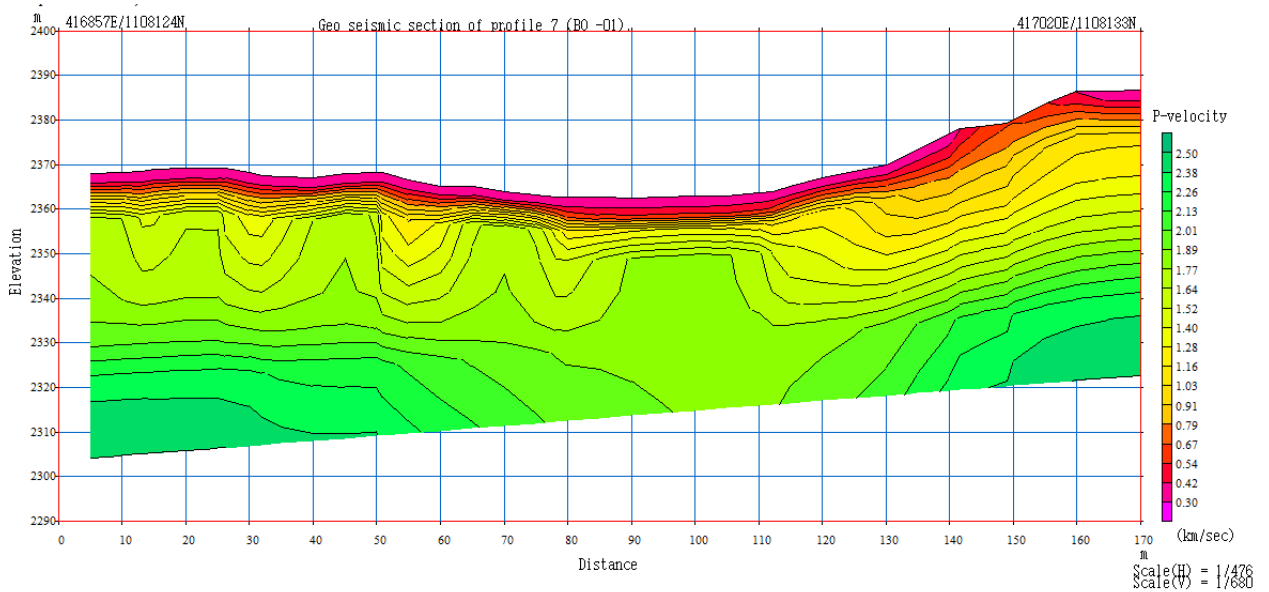


Fig 2. Analytical diagram of velocity profile of L/S 0: Traverse line BO-01

(ii) L/S: Traverse line BO-02

Shown in Fig 3 is a travel-time curve for BO-02 while Fig 4 shows velocity profile of the same line.

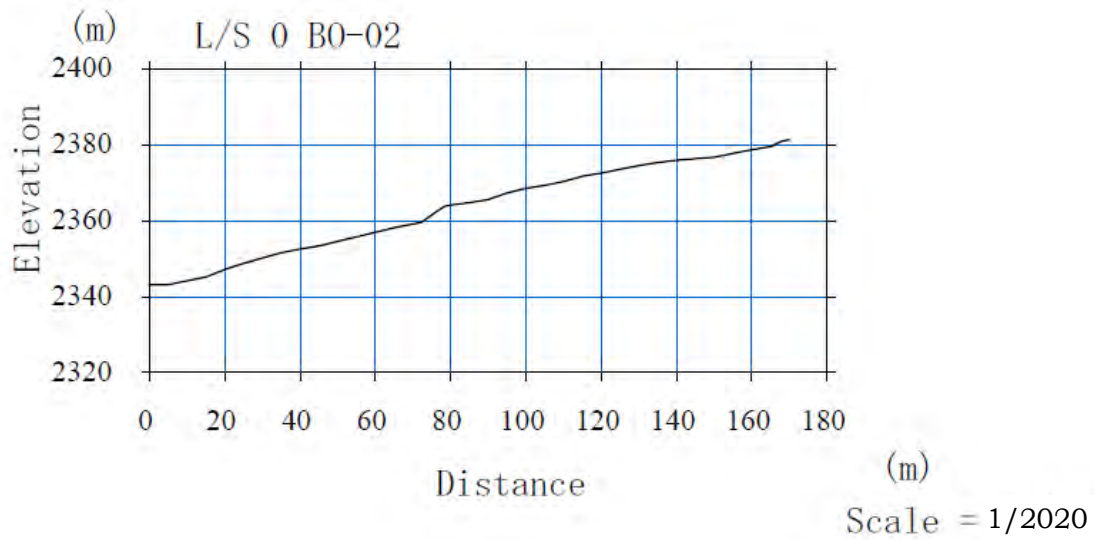


Fig 3. Section line of L/S 0: Traverse line BO-02

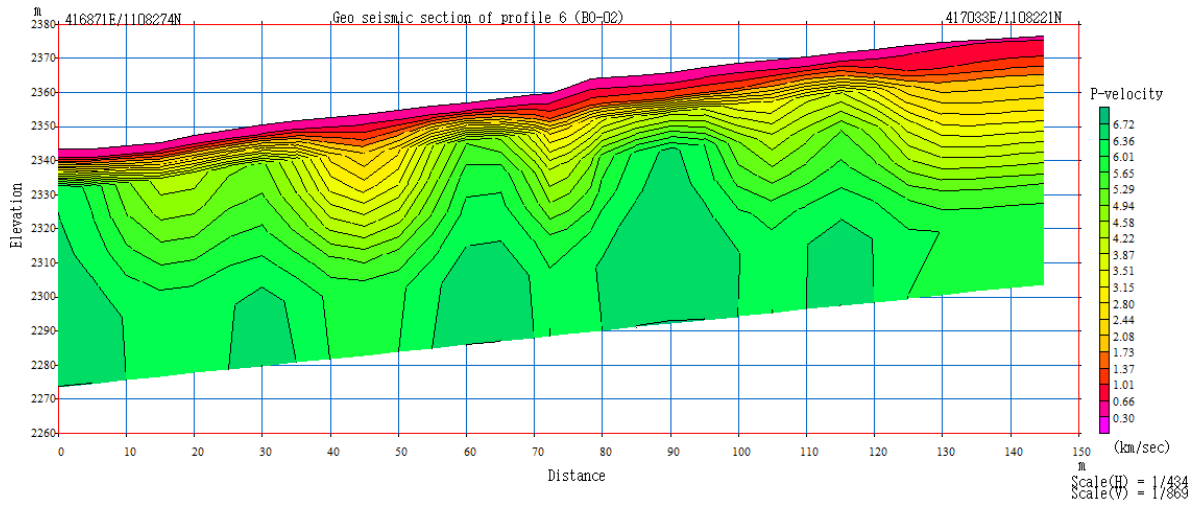


Fig 4. Analytical diagram of velocity profile of L/S 0: Traverse line BO-02

(iii) L/S 0: Traverse line BO-03

Shown in Fig 5 is a travel-time curve for BO-03 while Fig 6 shows velocity profile of the line.

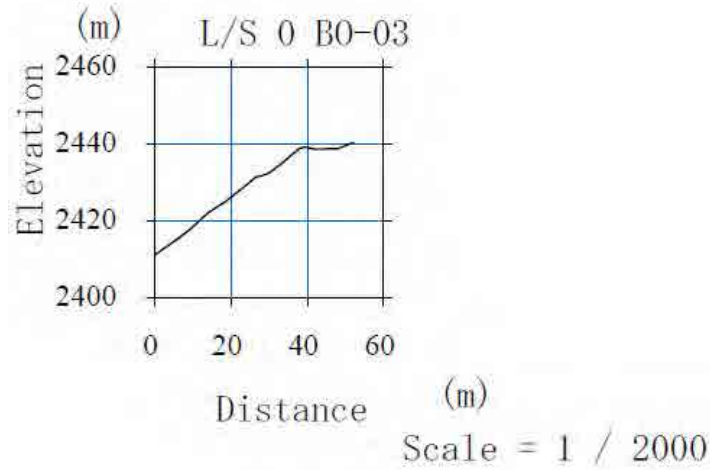


Fig 5. ~~Ša áÄ~~ ~~1-æÄ~~ ~~1-æÄ~~ of L/S 0: Traverse line BO-03

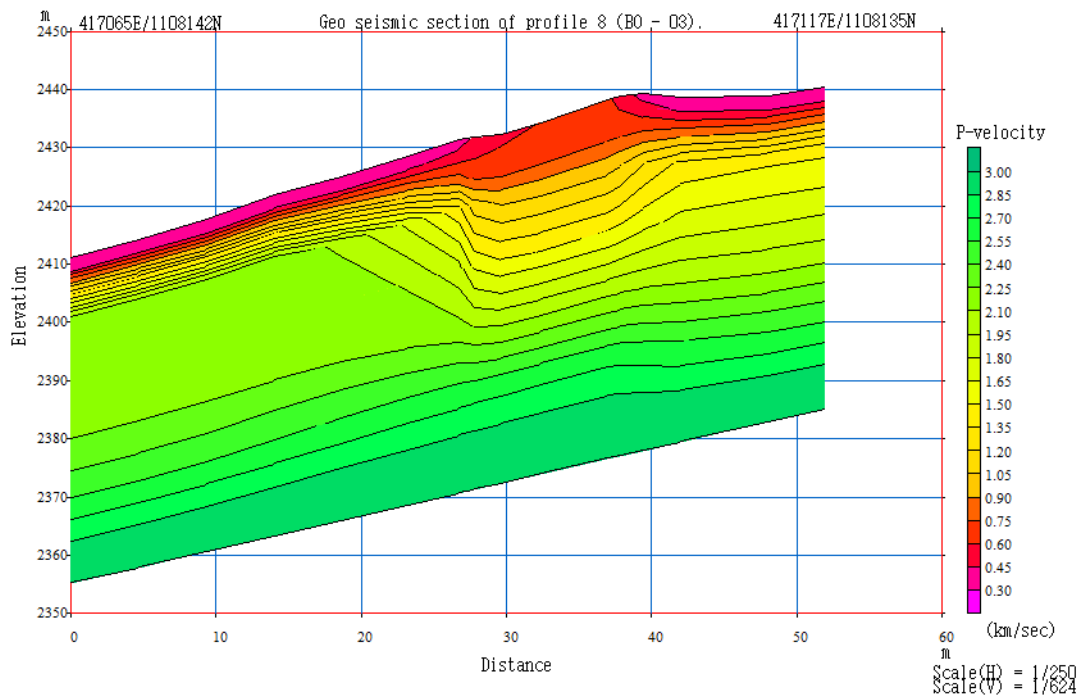


Fig 6. Analytical diagram of velocity profile of L/S 0: Traverse line BO-03



(iv) L/S 5: Traverse line BO-04

Shown in Fig 7 is a travel-time curve for BO-04 while, Fig 8 shows velocity profile of the line.

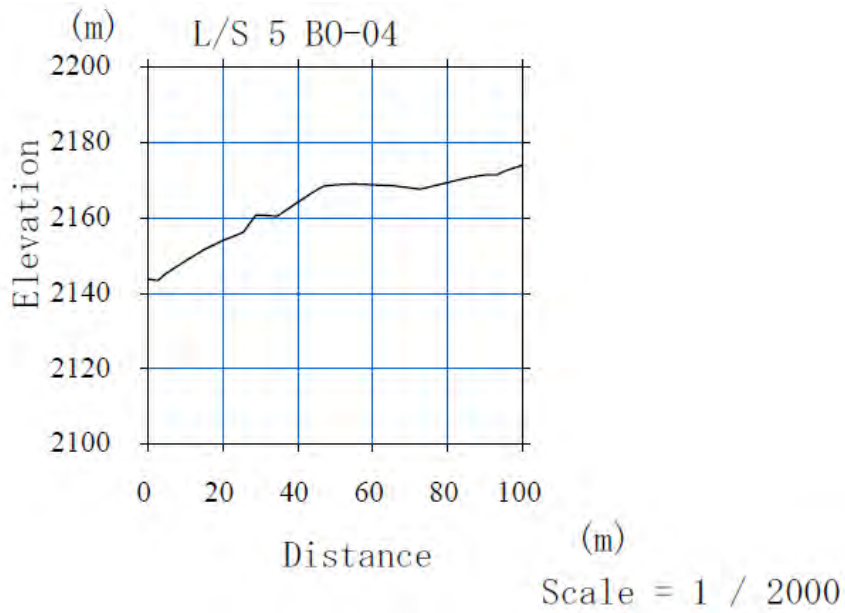


Fig 7. Šaržár - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25 - 26 - 27 - 28 - 29 - 30 - 31 - 32 - 33 - 34 - 35 - 36 - 37 - 38 - 39 - 40 - 41 - 42 - 43 - 44 - 45 - 46 - 47 - 48 - 49 - 50 - 51 - 52 - 53 - 54 - 55 - 56 - 57 - 58 - 59 - 60 - 61 - 62 - 63 - 64 - 65 - 66 - 67 - 68 - 69 - 70 - 71 - 72 - 73 - 74 - 75 - 76 - 77 - 78 - 79 - 80 - 81 - 82 - 83 - 84 - 85 - 86 - 87 - 88 - 89 - 90 - 91 - 92 - 93 - 94 - 95 - 96 - 97 - 98 - 99 - 100 of L/S 5: Traverse line BO-04

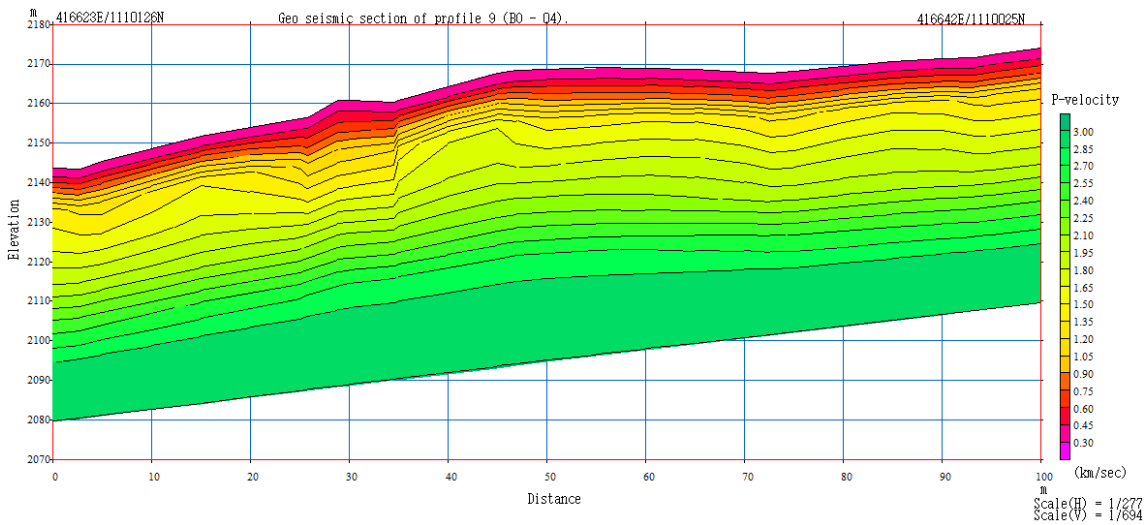


Fig 8. Analytical diagram of velocity profile of L/S 5: Traverse line BO-04

(v) L/S 5: Traverse line BO-05

Shown in Fig 9 is a travel-time curve for BO-05 while Fig 10 shows velocity profile of the line.

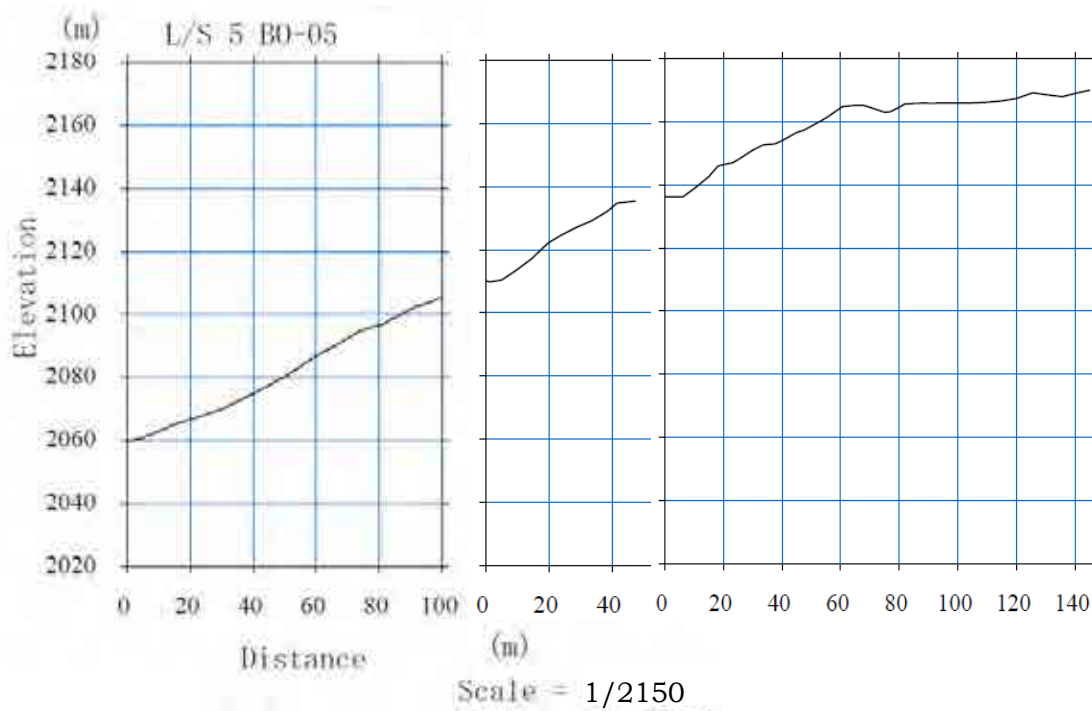


Fig 9. Section of profile 10 of L/S 5: Traverse line BO-05

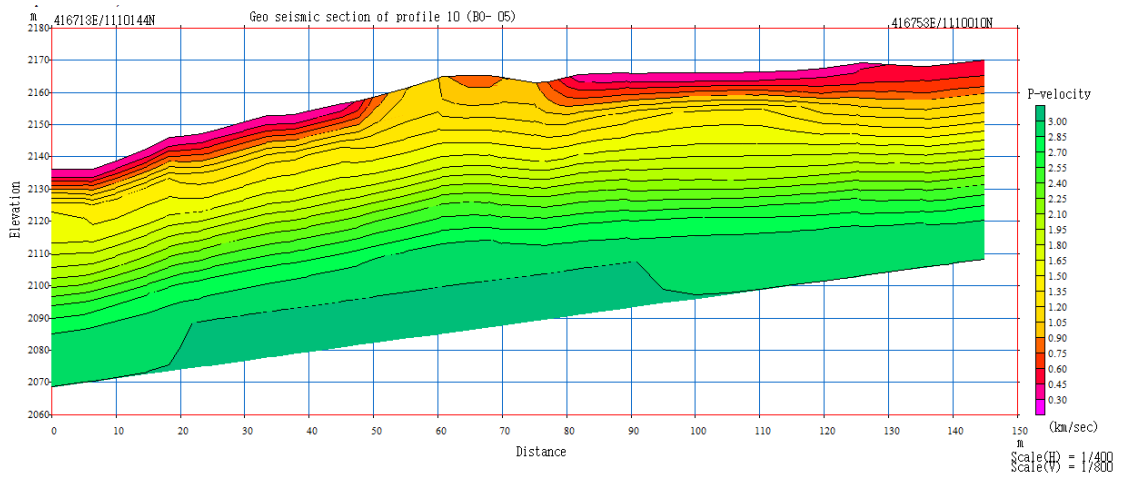


Fig 10. Analytical diagram of velocity profile of L/S 5: Traverse line BO-05

(vi) L/S 5: Traverse line BO-06

Shown in Fig 11 is a travel-time curve for BO-06 while Fig 12 shows velocity profile of the line.

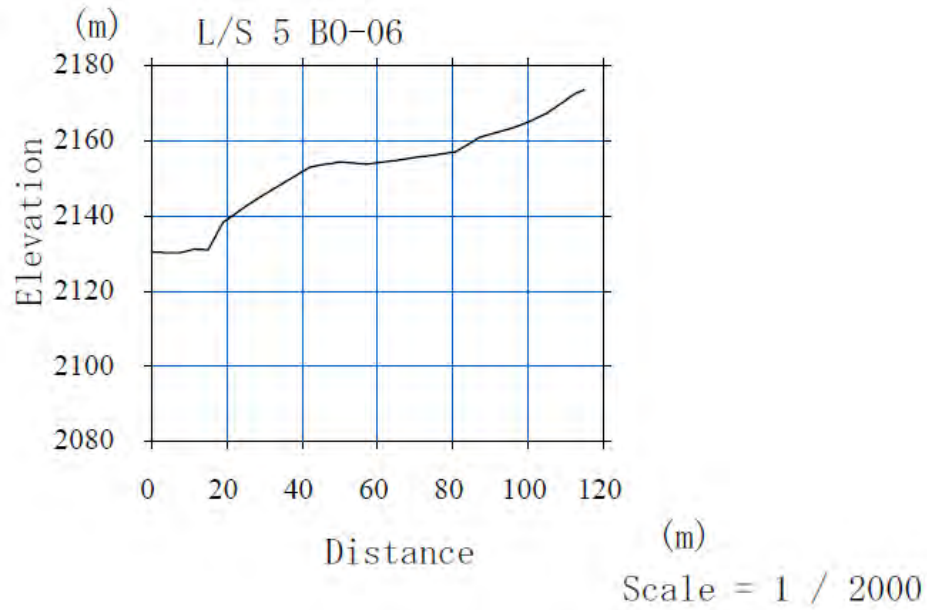


Fig 11. Travel-time curve of L/S 5: Traverse line BO-06

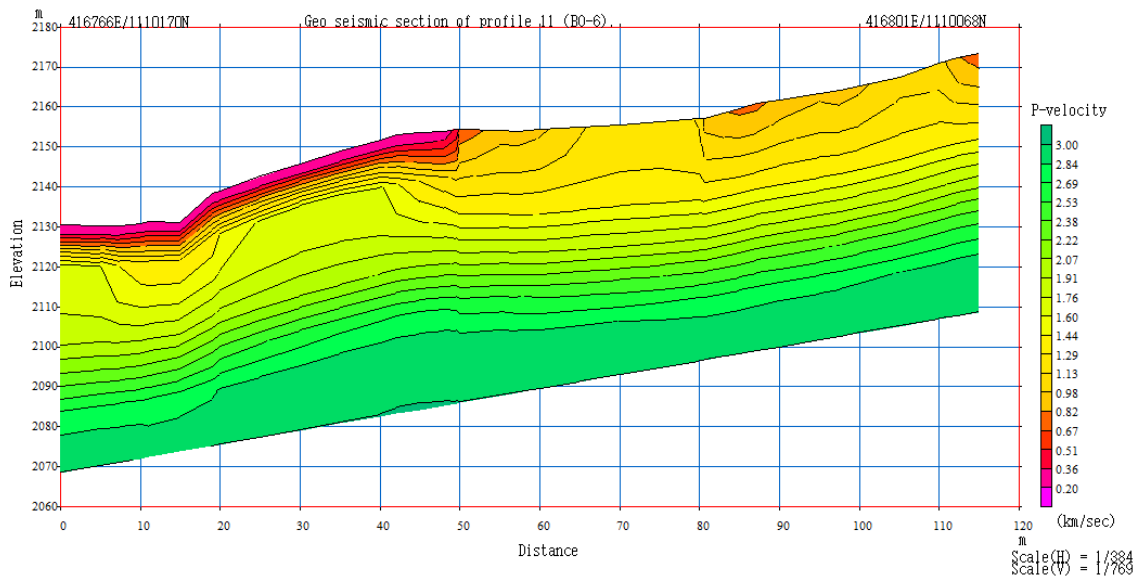


Fig 12. Analytical diagram of velocity profile of L/S 5: Traverse line BO 06

(vii) L/S 22: Traverse line BO-07

Shown in Fig 13 is a travel-time curve for BO-07 while Fig 14 shows velocity profile of the line.

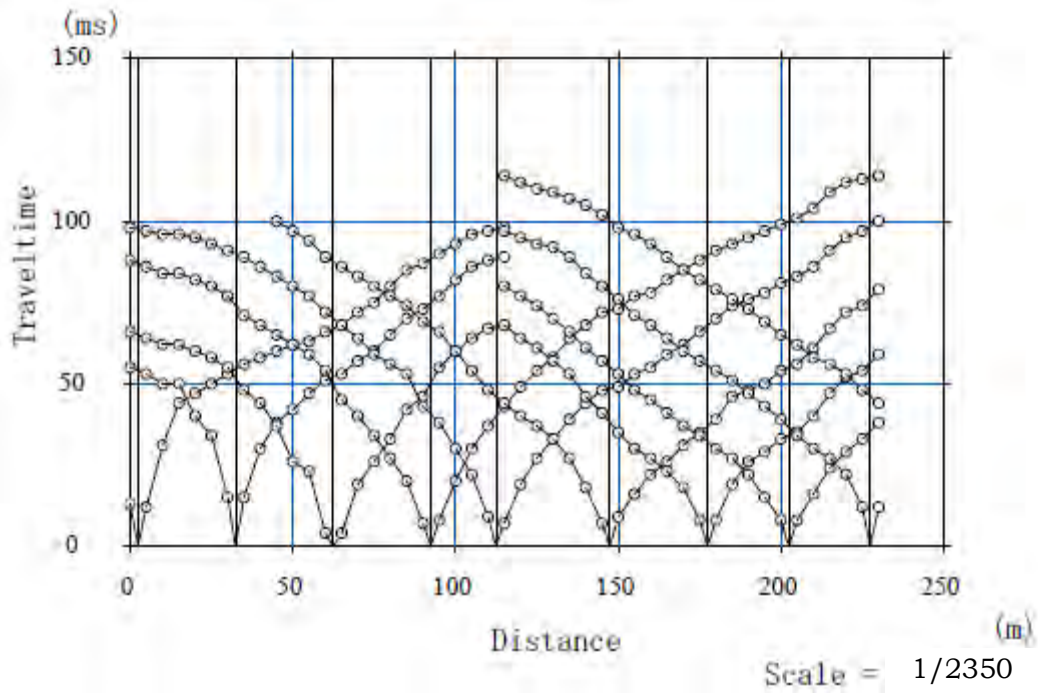


Fig 13. Travel-time curve of L/S 22: Traverse line BO-07

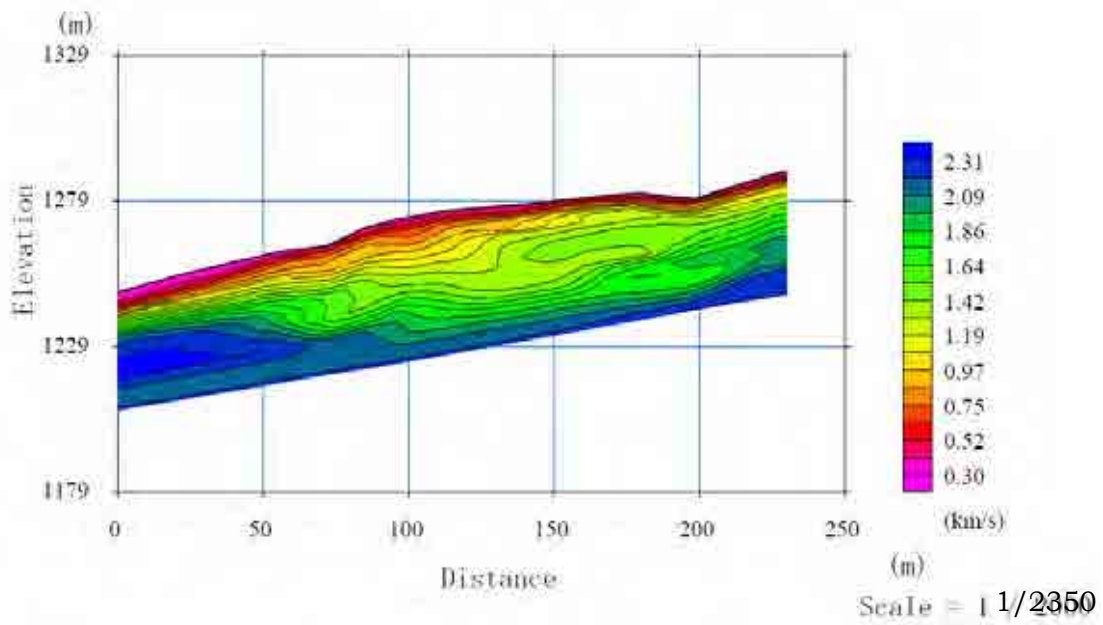


Fig 14. Analytical diagram of velocity profile of L/S 22: Traverse line BO-07



(viii) L/S 27: Traverse line BO-08

Shown in Fig 15 is a travel-time curve for BO-08 while Fig 16 shows velocity profile of the line.

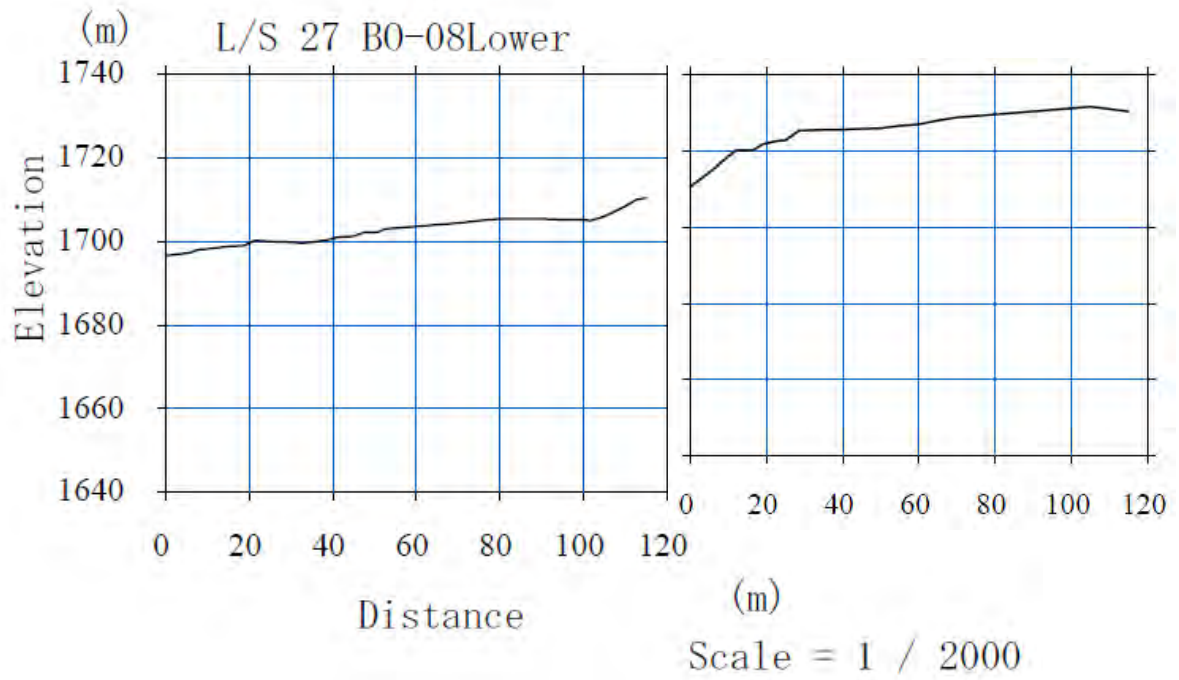


Fig 15. Section of L/S 27: Traverse line BO-08

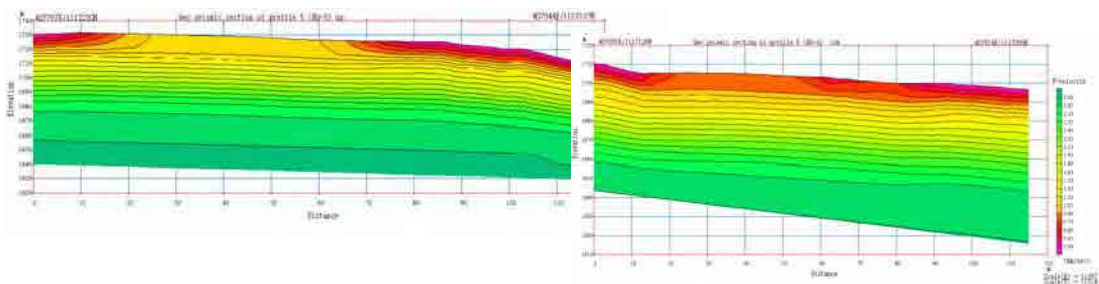


Fig 16. Analytical diagram of velocity profile of L/S 27: Traverse line BO-08

(ix) L/S 27: Traverse line BO-09

Shown in Fig 17 is a travel-time curve for BO-09 while Fig 18 shows velocity profile of the line.

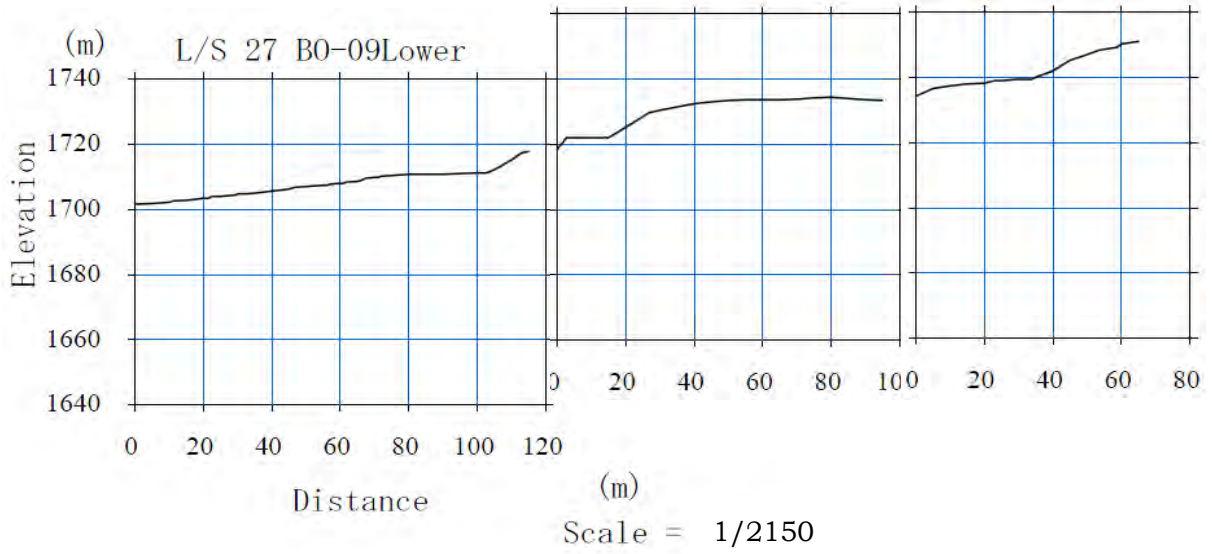


Fig 17. Section A-A of L/S 27: Traverse line BO-09

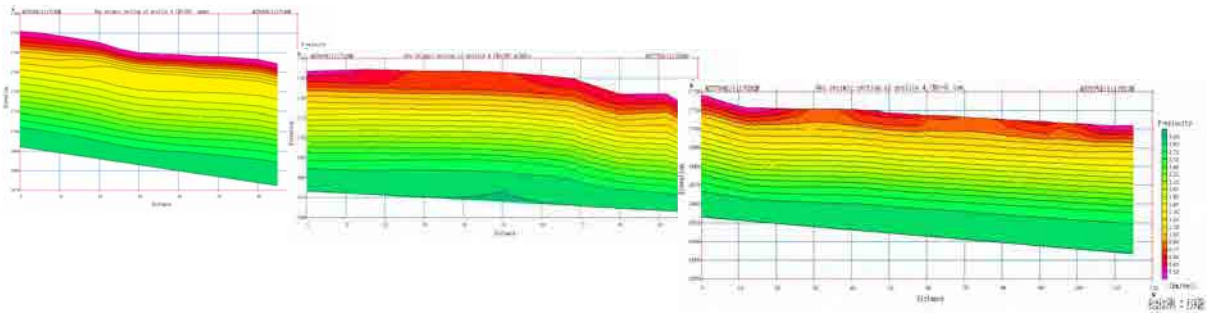


Fig 18. Analytical diagram of velocity profile of L/S 27: Traverse line BO-09

(x) L/S 28: Traverse line BO-10

Shown in Fig 19 is a travel-time curve for BO-10 while Fig 20 shows velocity profile of the line.

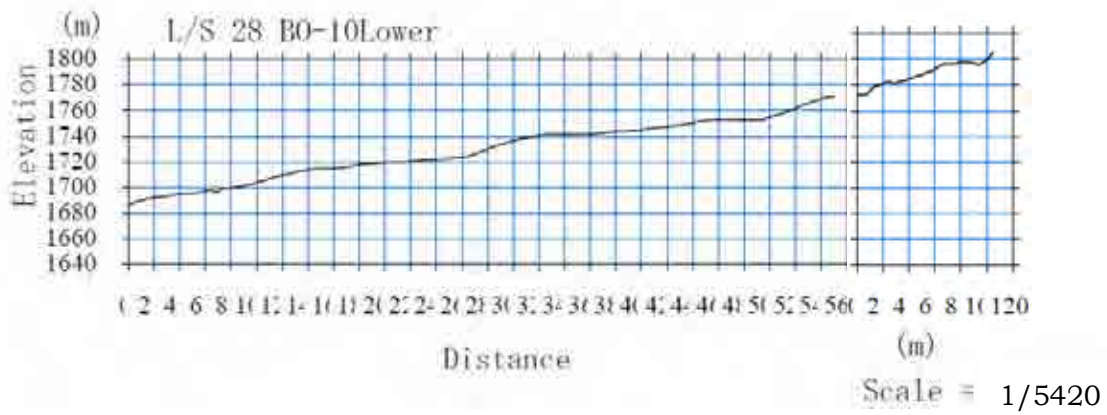


Fig 19. Land surface profile of L/S 28: Traverse line BO-10

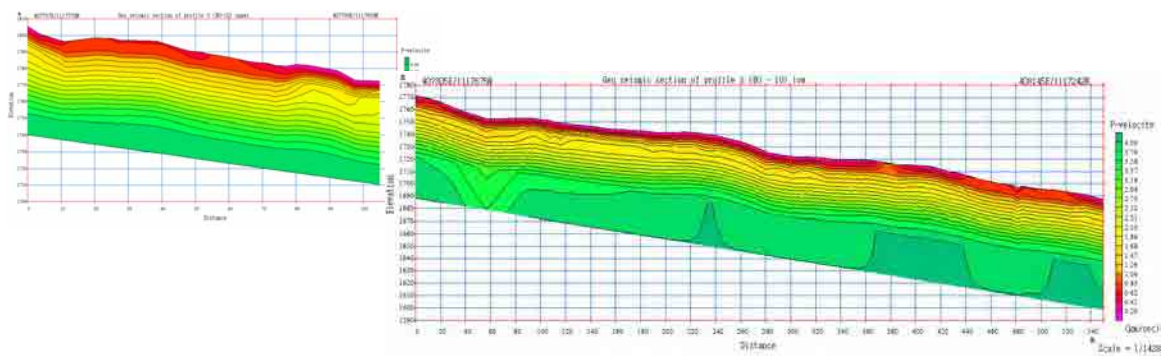


Fig 20. Analytical diagram of velocity profile of L/S 28: Traverse line BO-10

(xi) L/S 28: Traverse line BO-11

Shown in Fig 21 is a travel-time curve for BO-11 while Fig 22 shows velocity profile of the line.

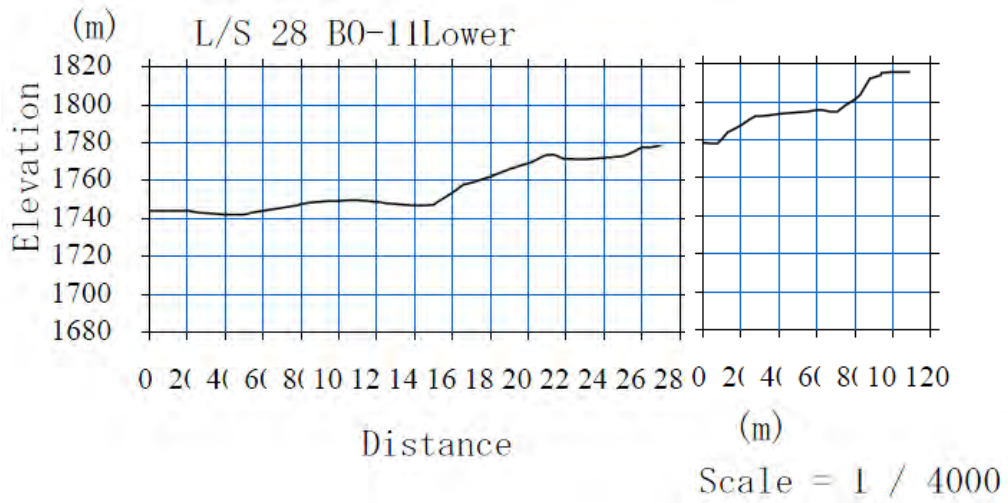


Fig 21. Land surface profile of L/S 28: Traverse line BO-11

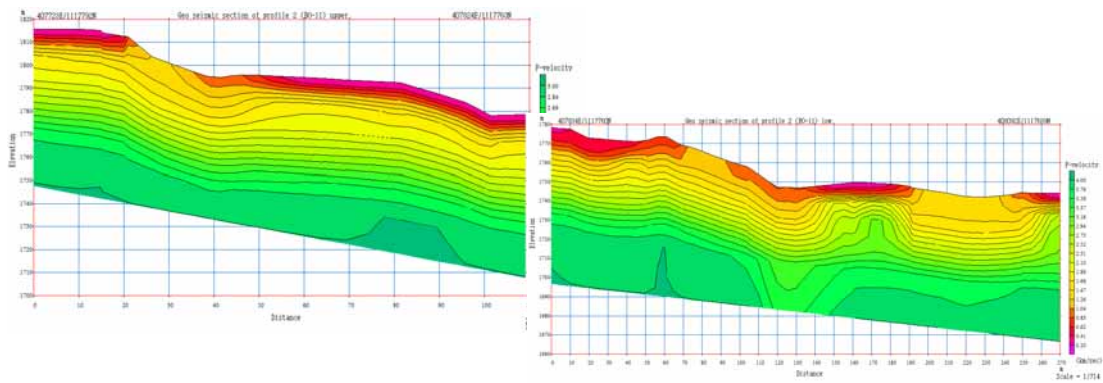


Fig 22. Analytical diagram of velocity profile of L/S 28: Traverse line BO-11



(2) Analysis Result of Electric Sounding

(i) Area L/S 0

(a) Traverse line BO-01

Under Preparation

(b) Traverse line BO-02

Under Preparation

(ii) Area L/S 5

(a) Traverse line BO-04

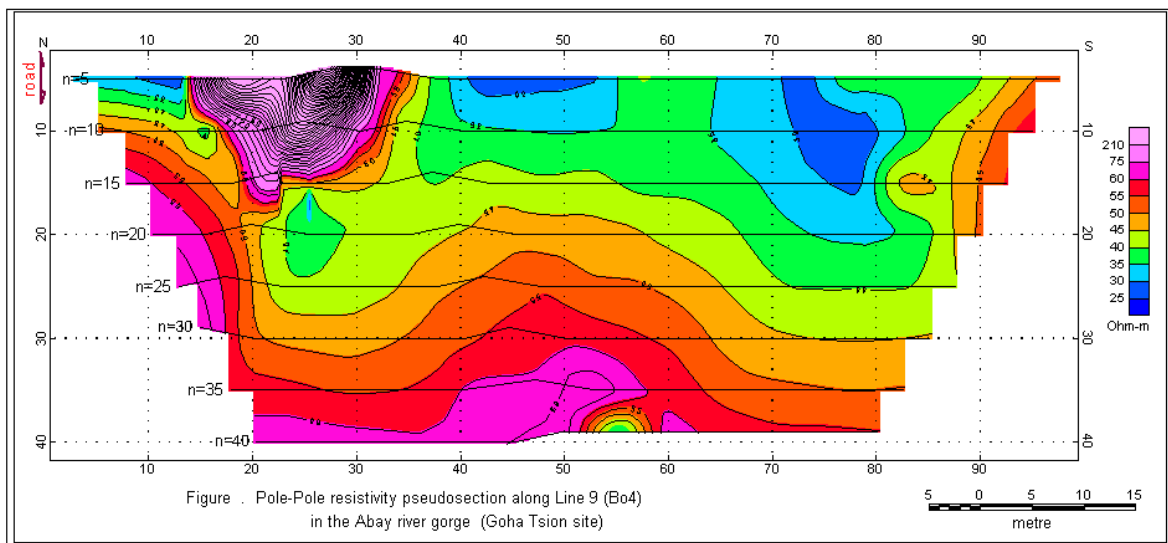


Fig 23. Resistivity Sectional View of BO-04

(b) Traverse line BO-05

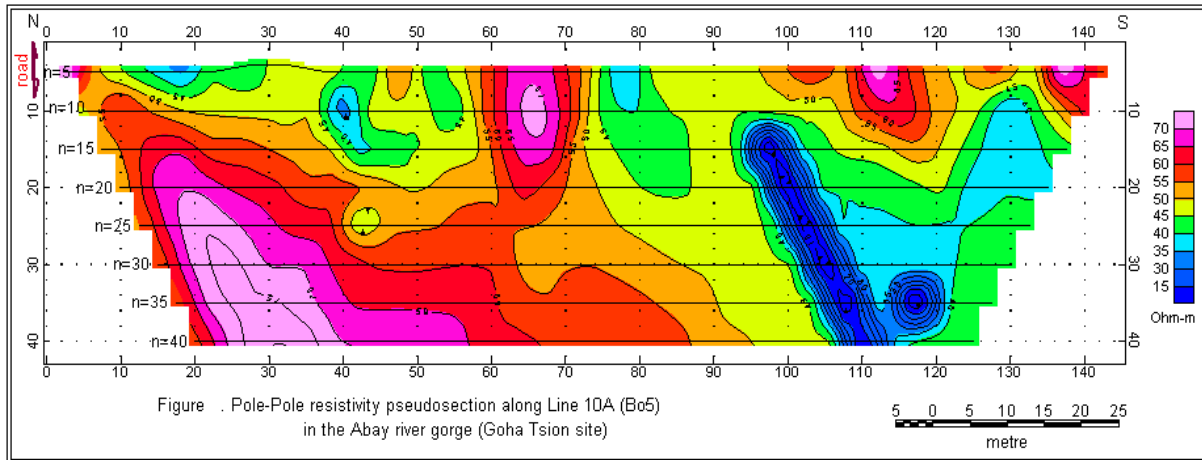


Fig 24. Resistivity Sectional View of BO-05( a )

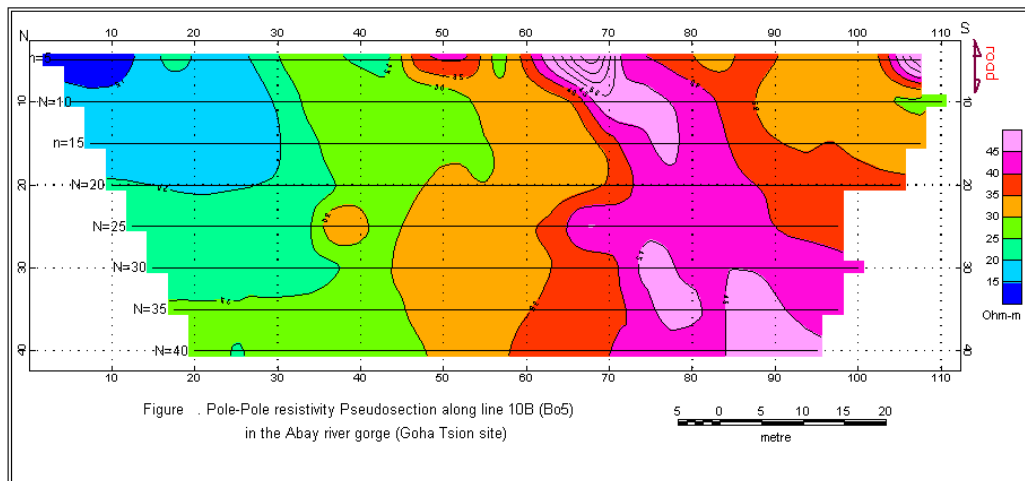


Fig 25. Resistivity Sectional View of BO-05( b )

(c) Traverse line BO-06

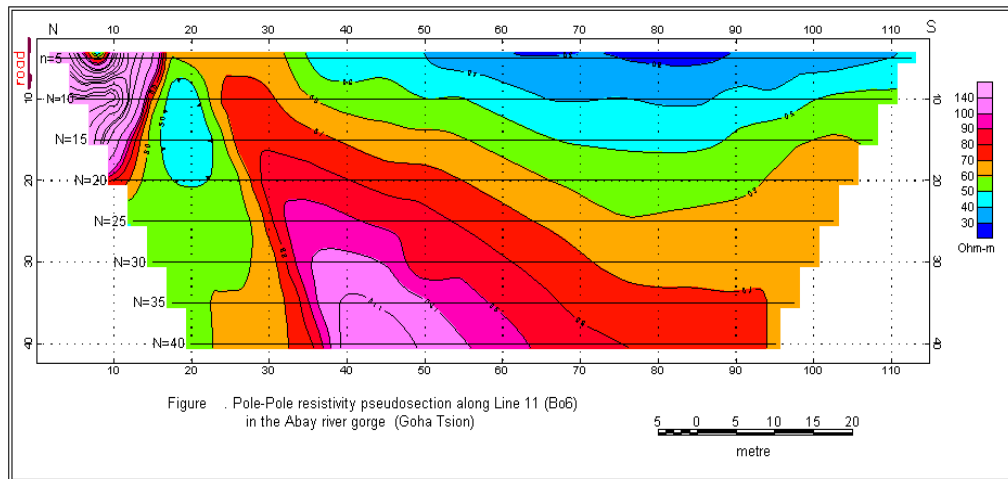


Fig 26. Resistivity Sectional View of BO-06

(iii) Area L/S 22

(a) Traverse line BO-07

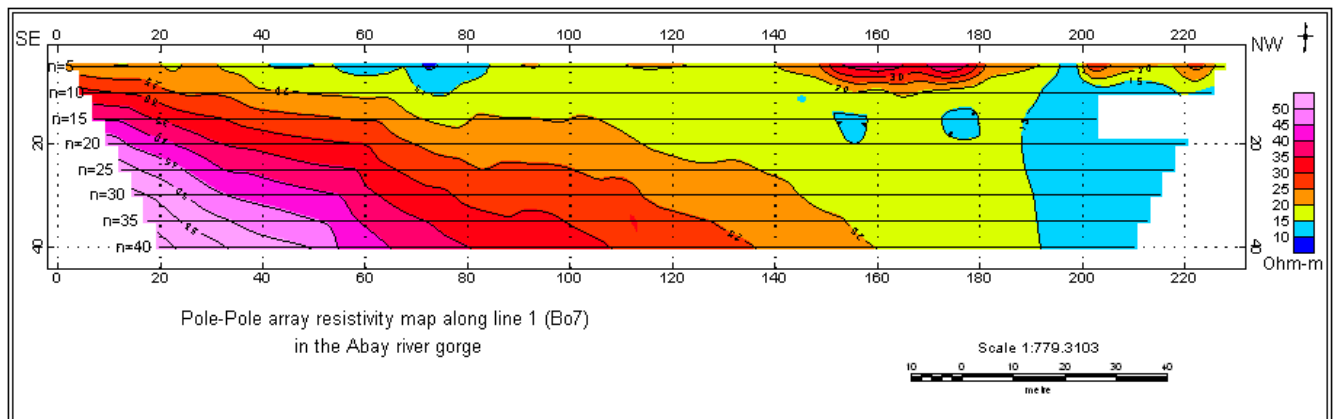


Fig 27. Resistivity Sectional View of BO-07

- (iv) Area L/S 27
  - (a) Traverse line BO-08  
Under Preparation
  - (b) Traverse line BO-09  
Under Preparation
- (v) Area L/S 28
  - (a) Traverse line BO-10

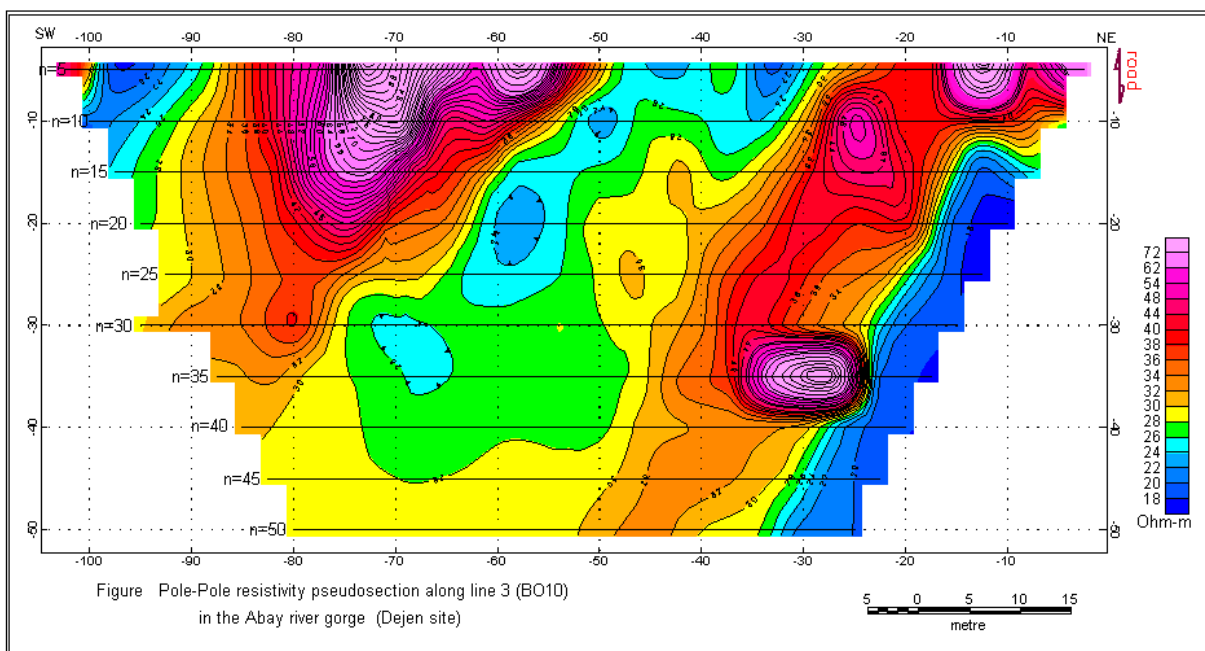


Fig 28. Resistivity Sectional View of BO-10



(b) Traverse line BO-11

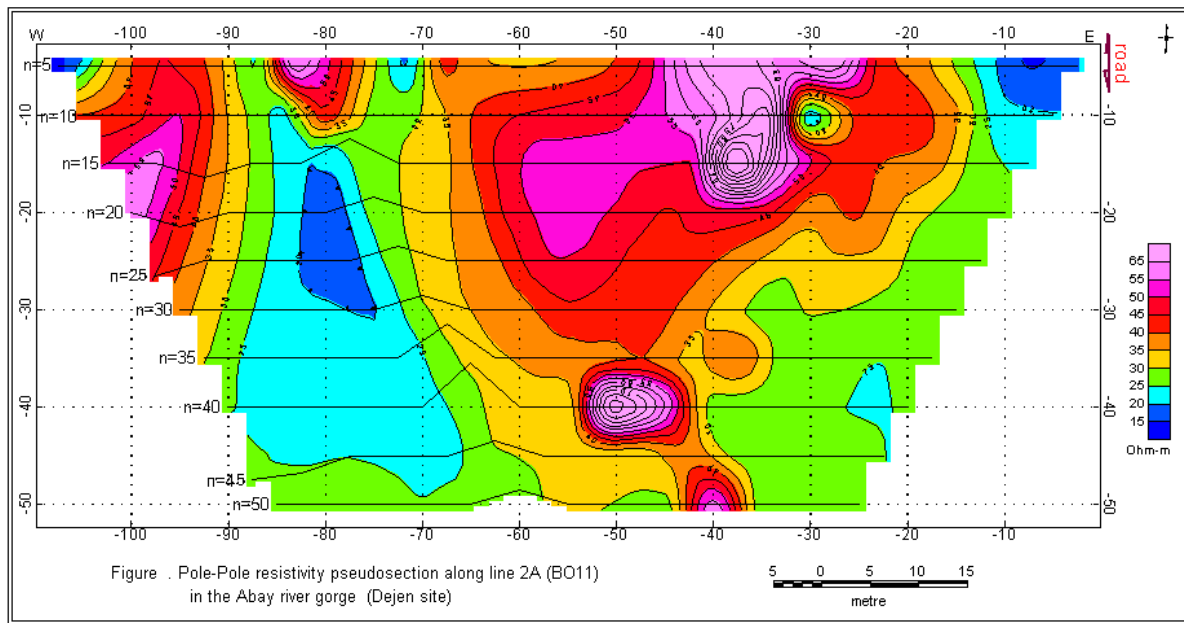


Fig 29. Resistivity Sectional View of BO-11( a )

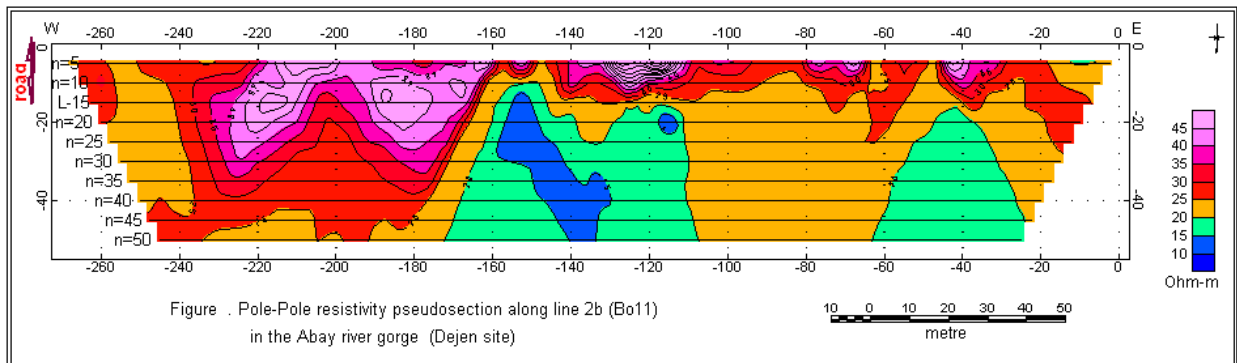


Fig 30. Resistivity Sectional View of BO-11(b)

