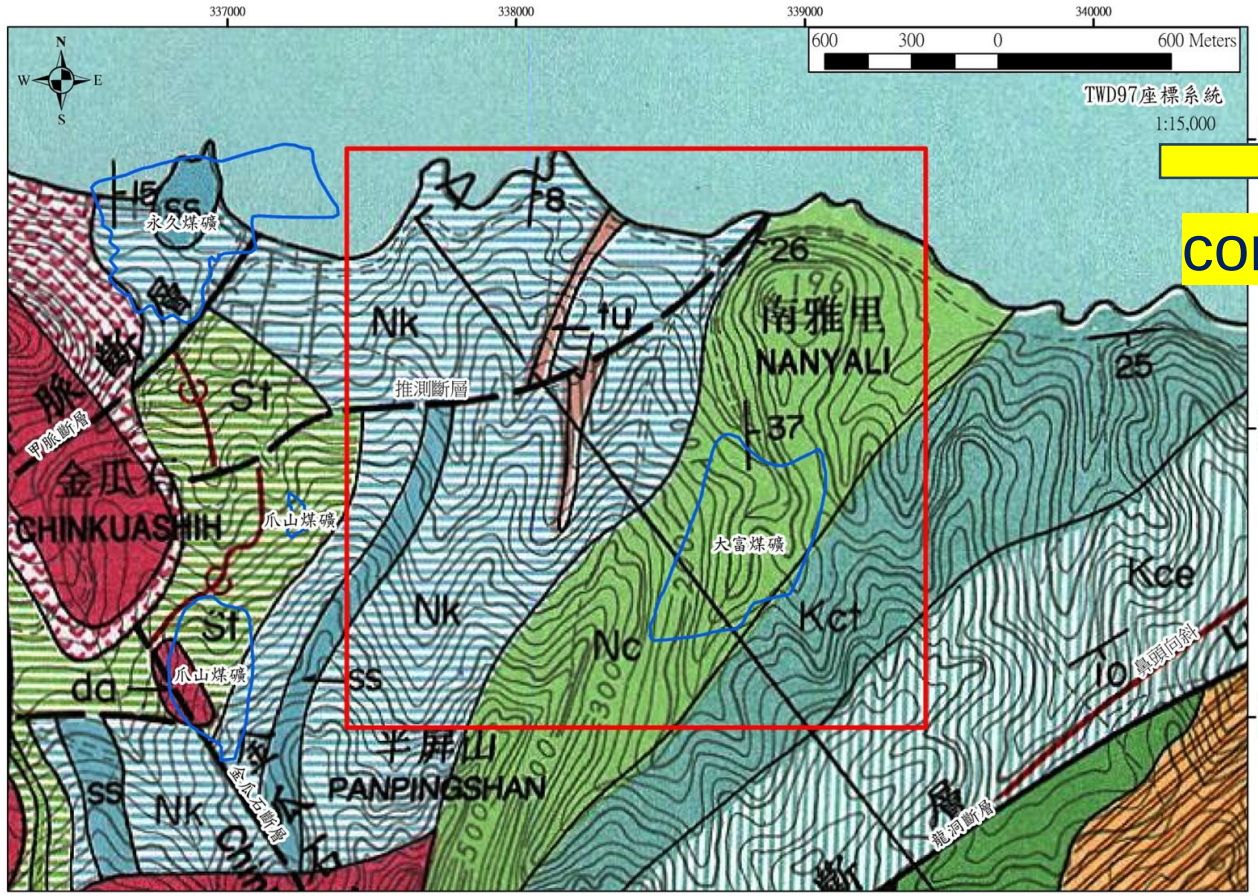
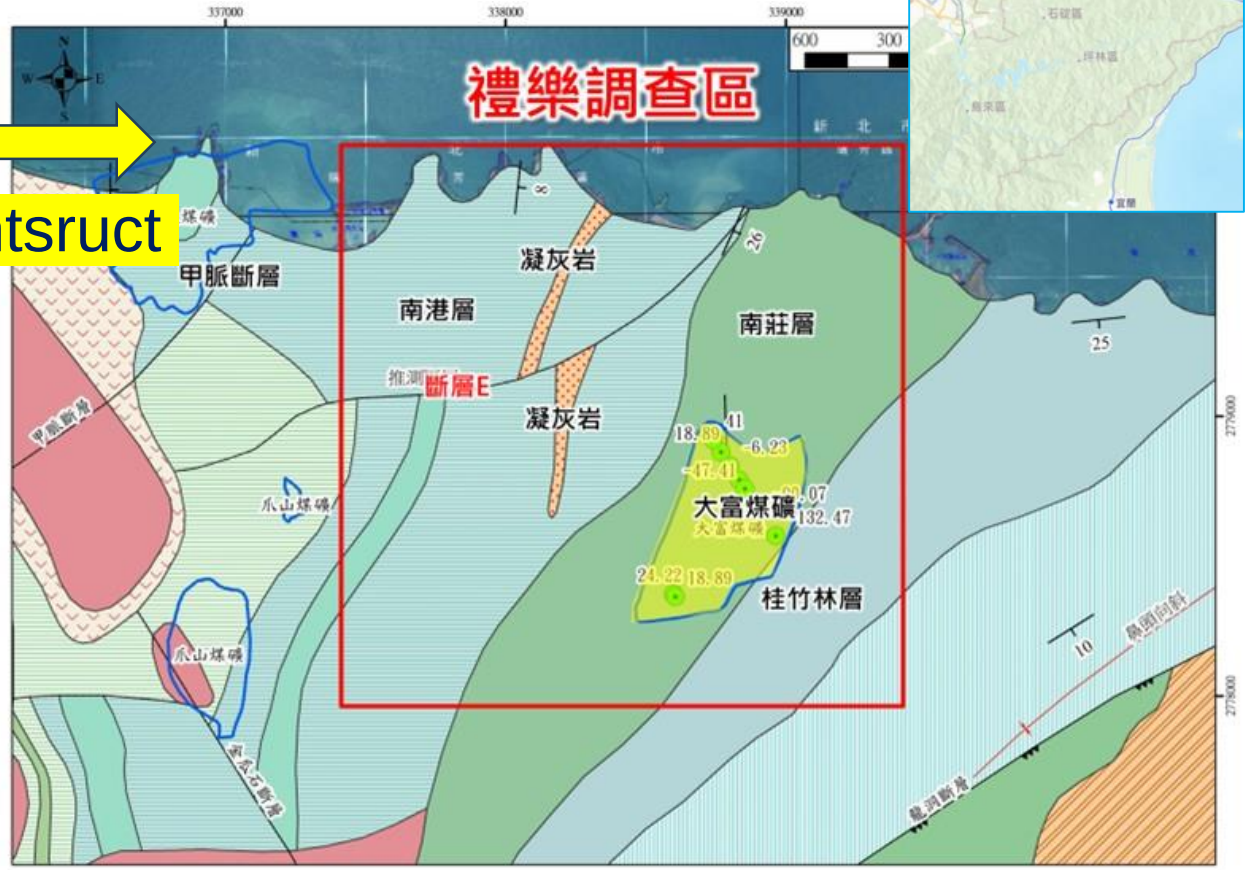
Build 3D geological model and draw an exquisite regional geological map by using polynomial equation and subsurface data.

Presenter: Tseng-Chih-Ching曾志清
Adviser: Professor Jia-Jung. Dong
Date: 2025/05/02

Motivation



contsruct



Source:地礦中心1/50000區域地質圖

Traditional geological map

Exquisite regional geological map

This study:

- Seek to overcome the aforementioned limitations. (improved methods)
- Try to construct an exquisite 3D geological model which is reliable depth control, lateral continuity, and regional representativeness.

Study Flowchart

Improve traditional geological approaches to create an exquisite regional geological

Motivation

Reference data :
*Coast geological map. (Ho, et al., 1962)
*Measured topographic map of the coal mine (地礦中心圖資)
*Shih, 2018; 轉繪1/50000-雙溪圖幅 .台電.SINO顧問 report

Representative Beddings

Subsurface: coal mine data

Ground: 1m_ DEM

Regression using polynomial equation

Data & Method

Reasonable RMSE, Shape of the strata surface

Modify model: Tangential plane

Iteration

Coal mine point

3D Strata / fault plane/ fold axis…

Result

Reference surface

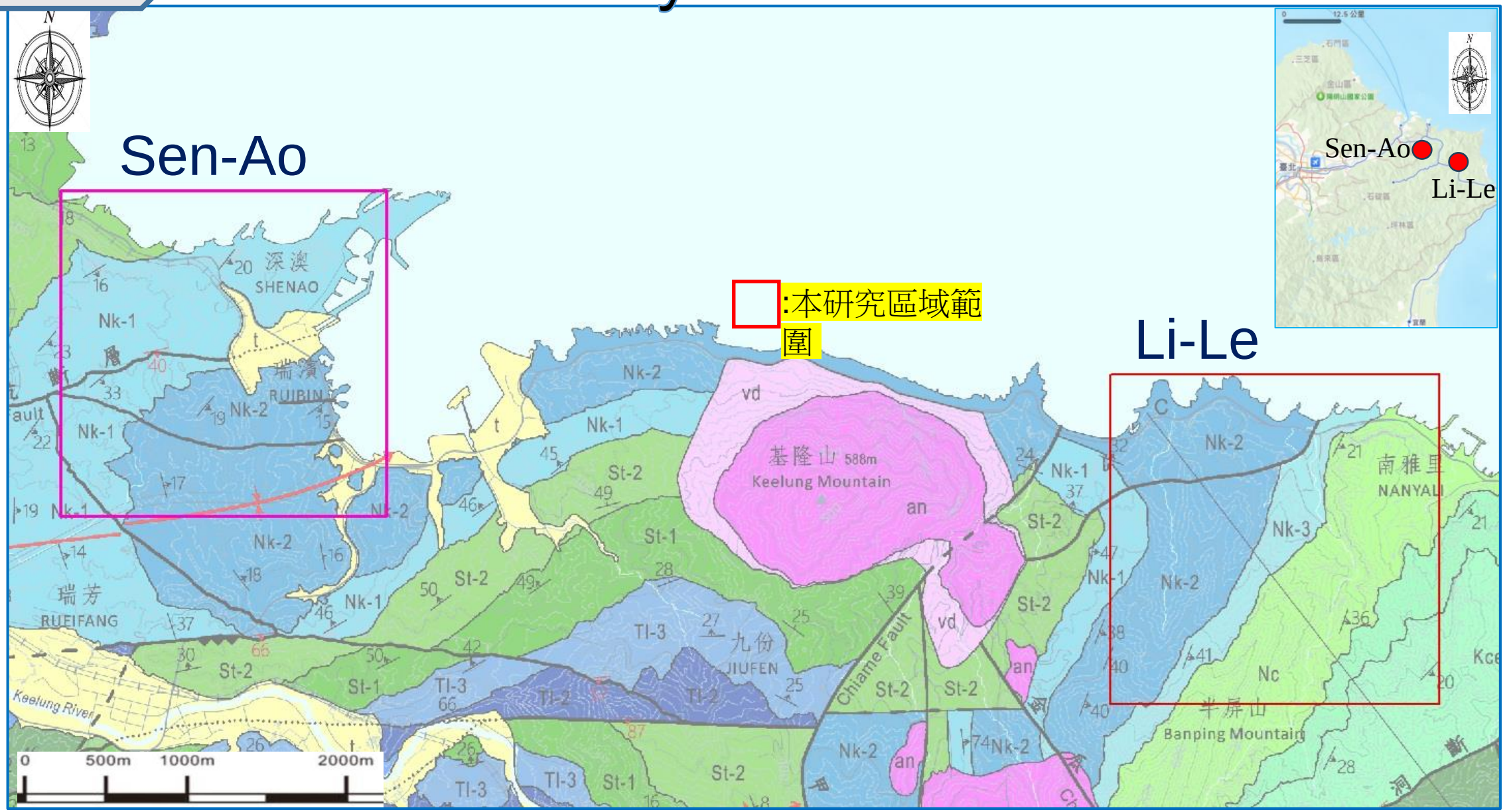
Geological Structure, strata boundaries

Discussion

Create an exquisite regional geological map

Target

Study area



Source:施乃慈轉繪地礦中心雙溪1/50000 Geologic

Representative Beddings

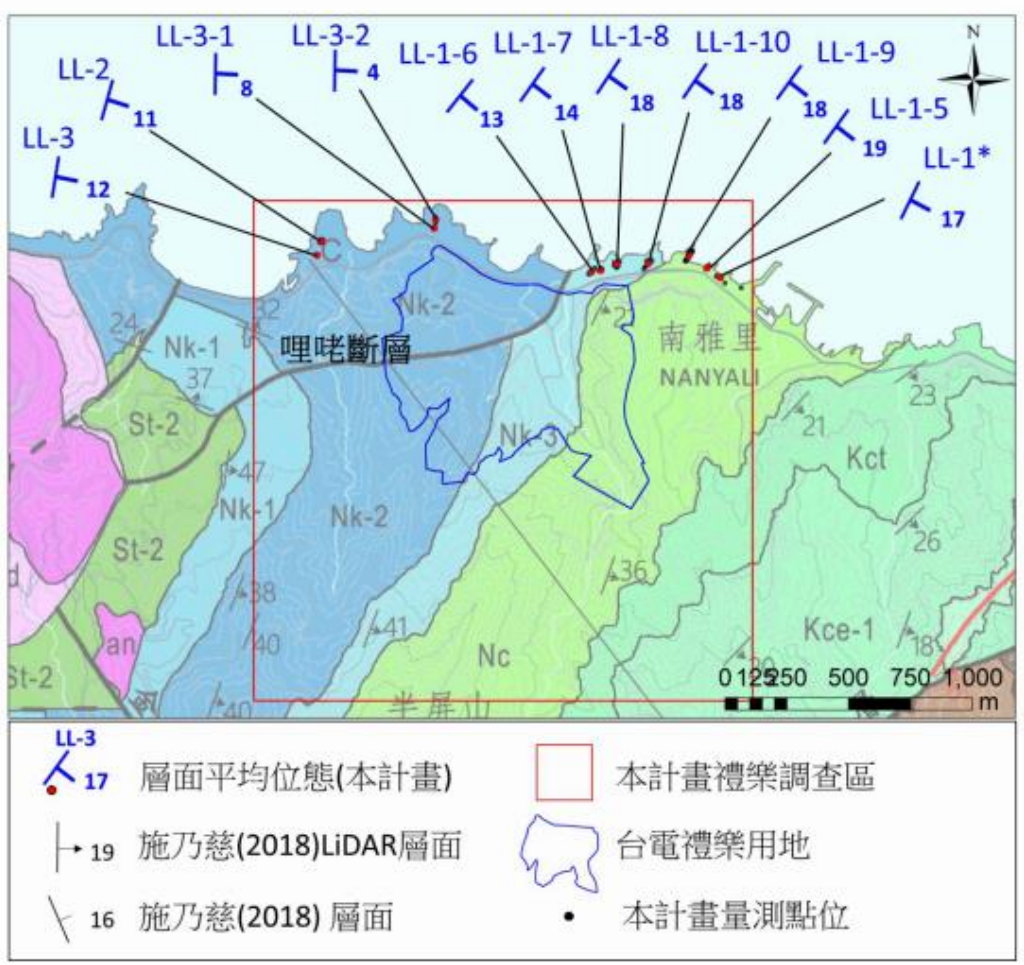
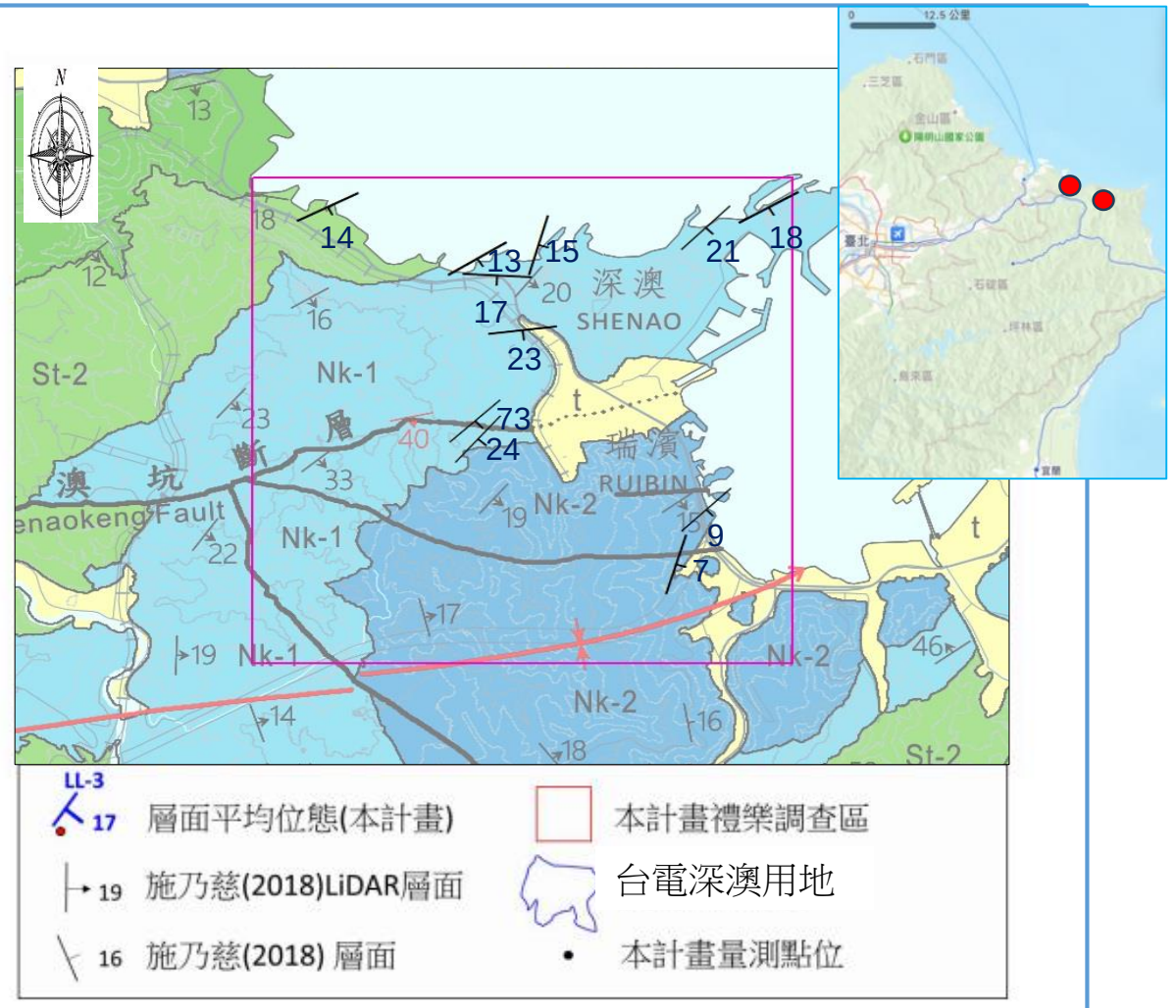


圖 3.3.3 禮樂區域平均位態。註：底圖為施乃慈(2018)五萬分之一地質圖。桂竹林層(Kct)、南莊層(Nc)、南港層(Nk)、石底層(St)。



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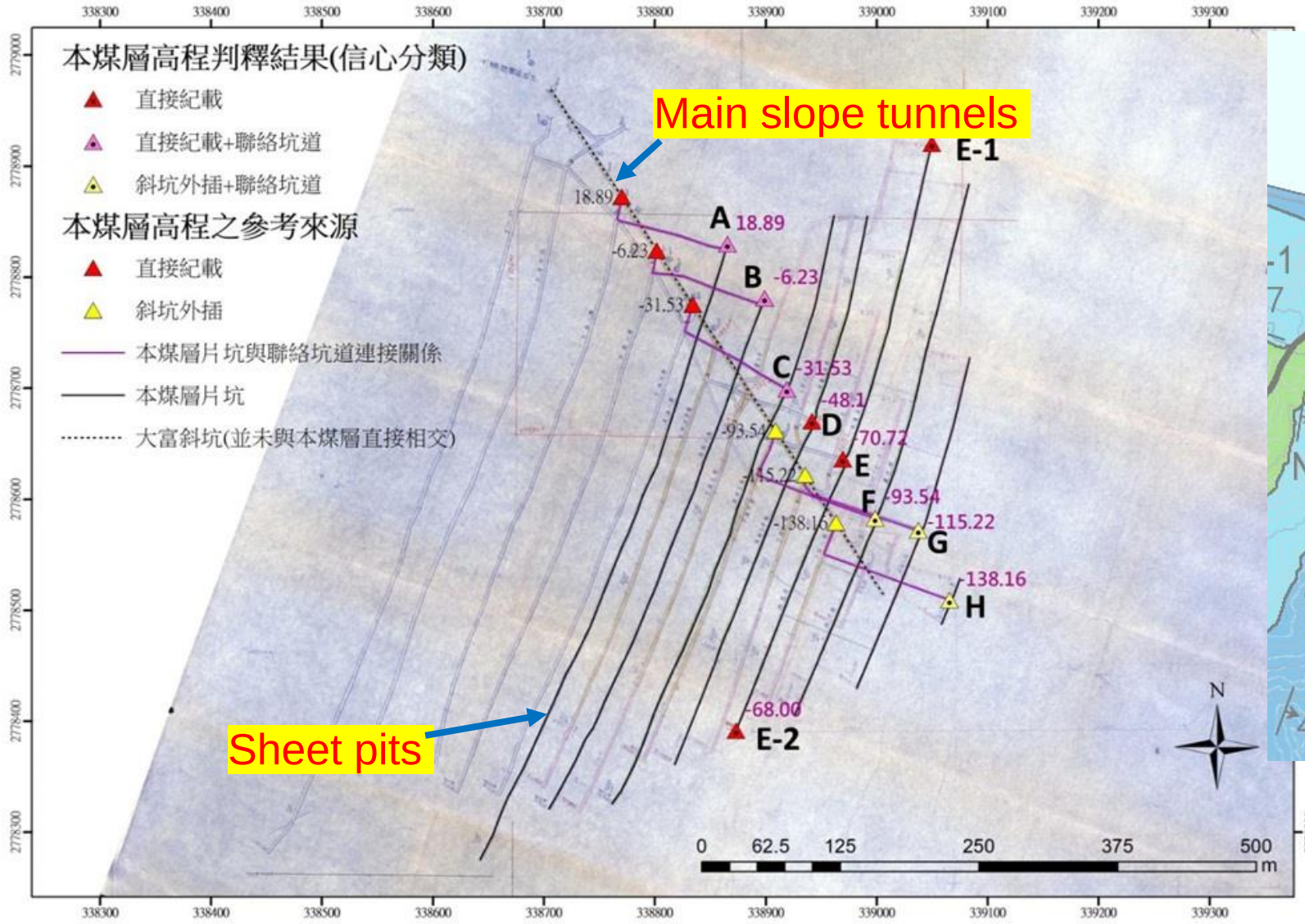
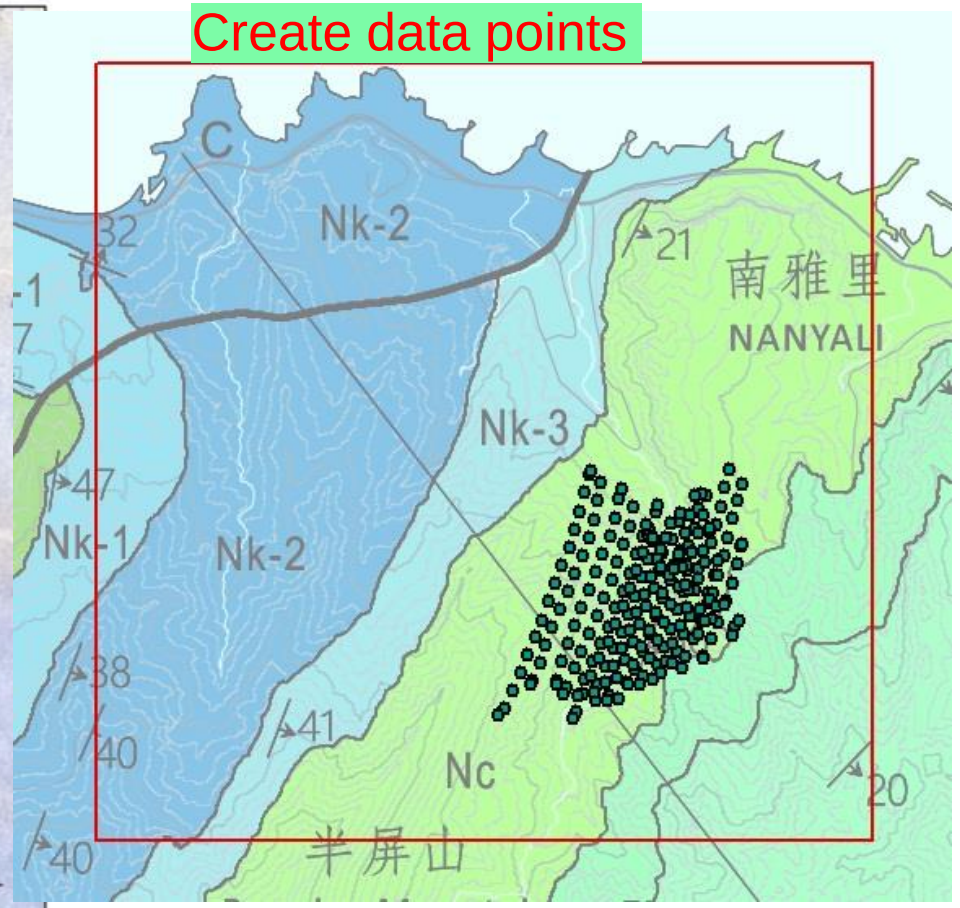
Data & Method

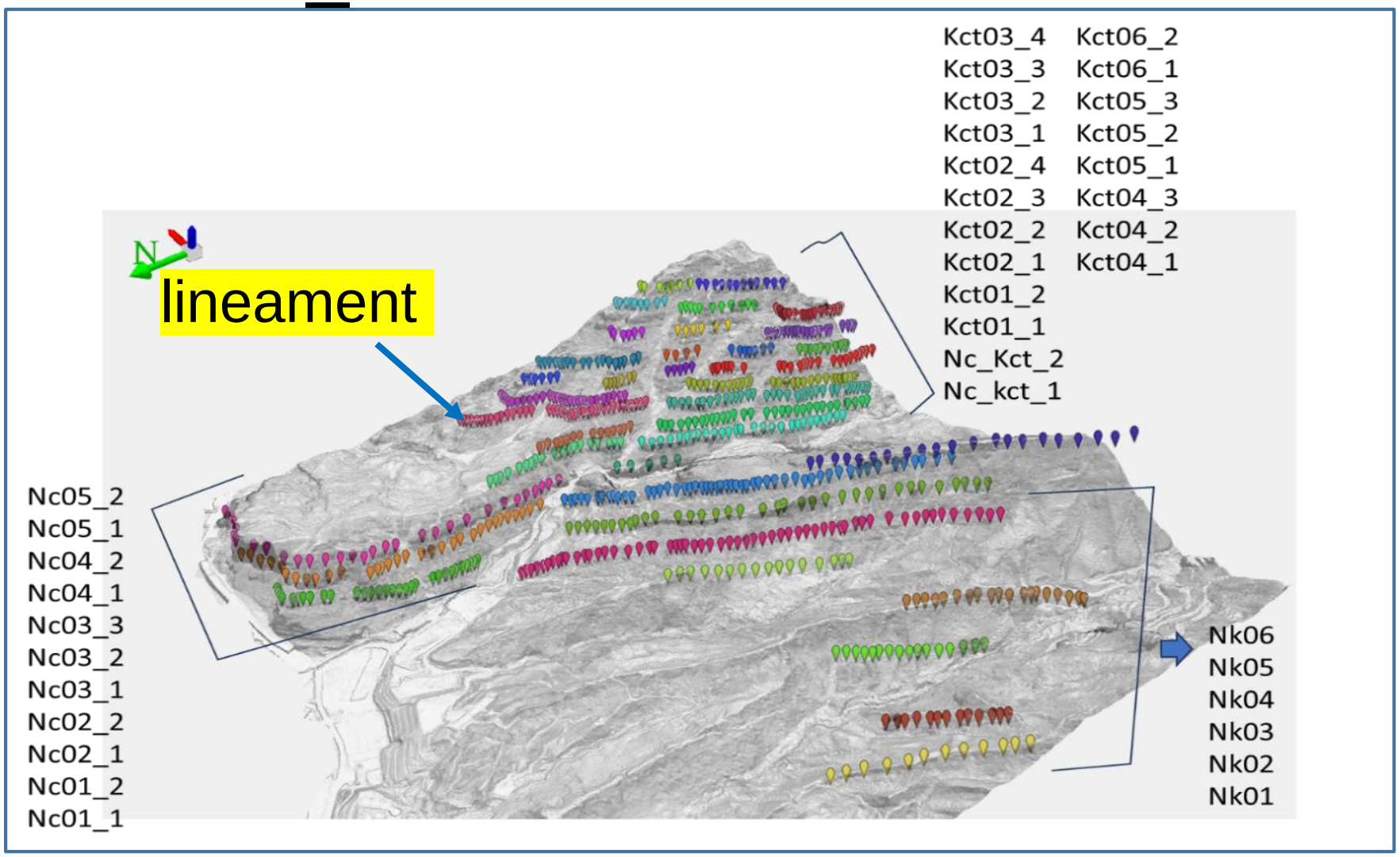
Subsurface data-大富coal mine





Data & Method

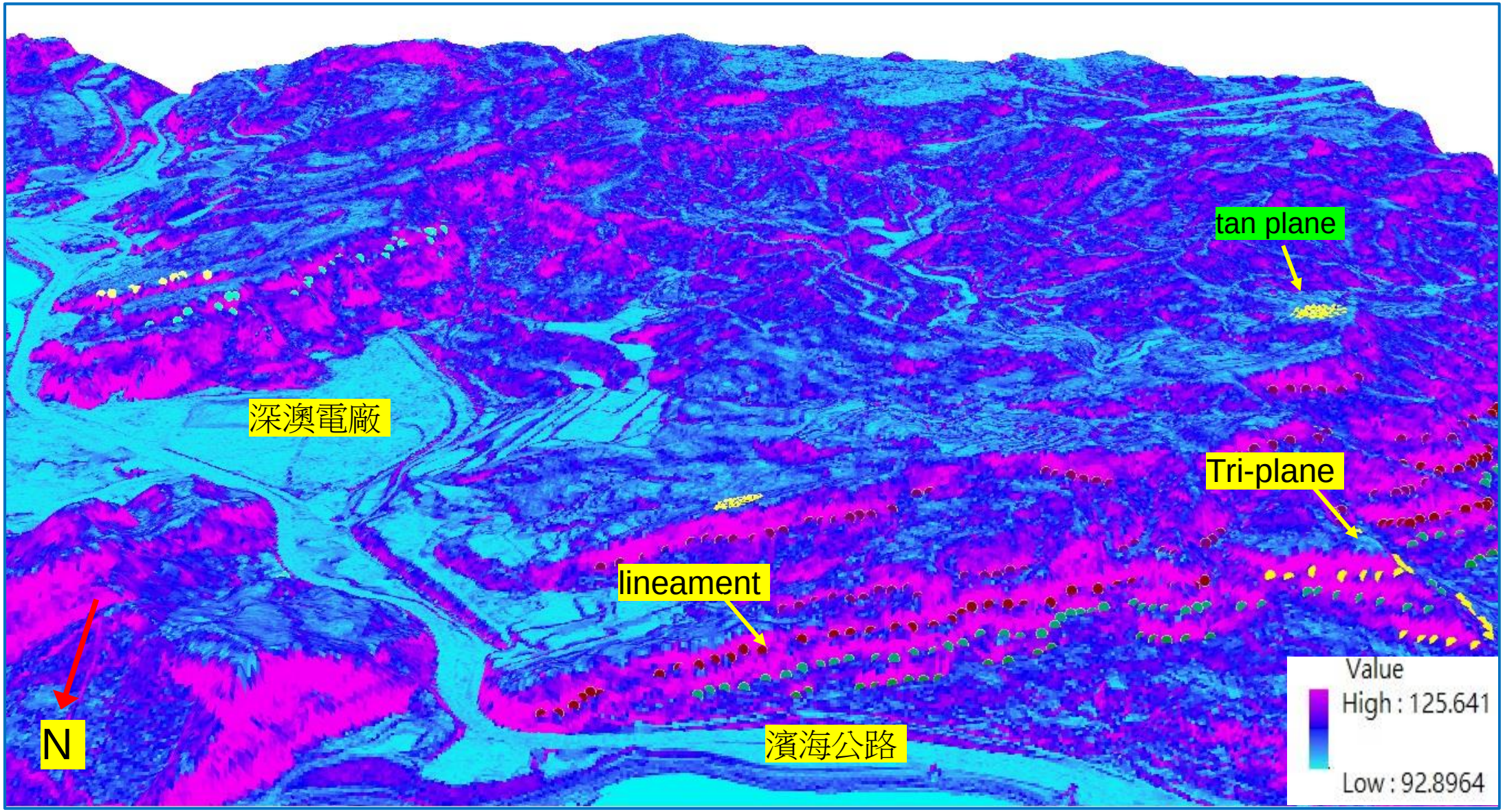
Ground: how to draw “Strata Lineament” 1m_ DEM



(**lineaments** ，LiLe)

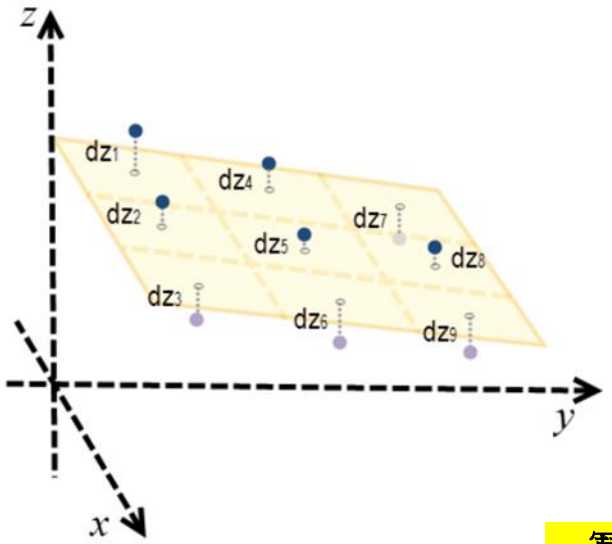
Data & Method

Ground - How to produce Tangential plane_Slope map -Shen-Ao



Data&Method

Unite regression surface + subsurface data to determine the morphology of the model



plane

平面/曲面 多項式

curved face

一冪次 $Z = m_1 + m_2x + m_3y$

二冪次 $Z = m_1 + m_2x + m_3y + m_4x^2 + m_5xy + m_6y^2$

三冪次 $Z = m_1 + m_2x + m_3y + m_4x^2 + m_5xy + m_6y^2 + m_7x^3 + m_8x^2y + m_9xy^2 + m_{10}y^3$

四冪次 $Z = m_1 + m_2x + m_3y + m_4x^2 + m_5xy + m_6y^2 + m_7x^3 + m_8x^2y + m_9xy^2 + m_{10}y^3 + m_{11}x^4 + m_{12}x^3y + m_{13}x^2y^2 + m_{14}xy^3 + m_{15}y^4$

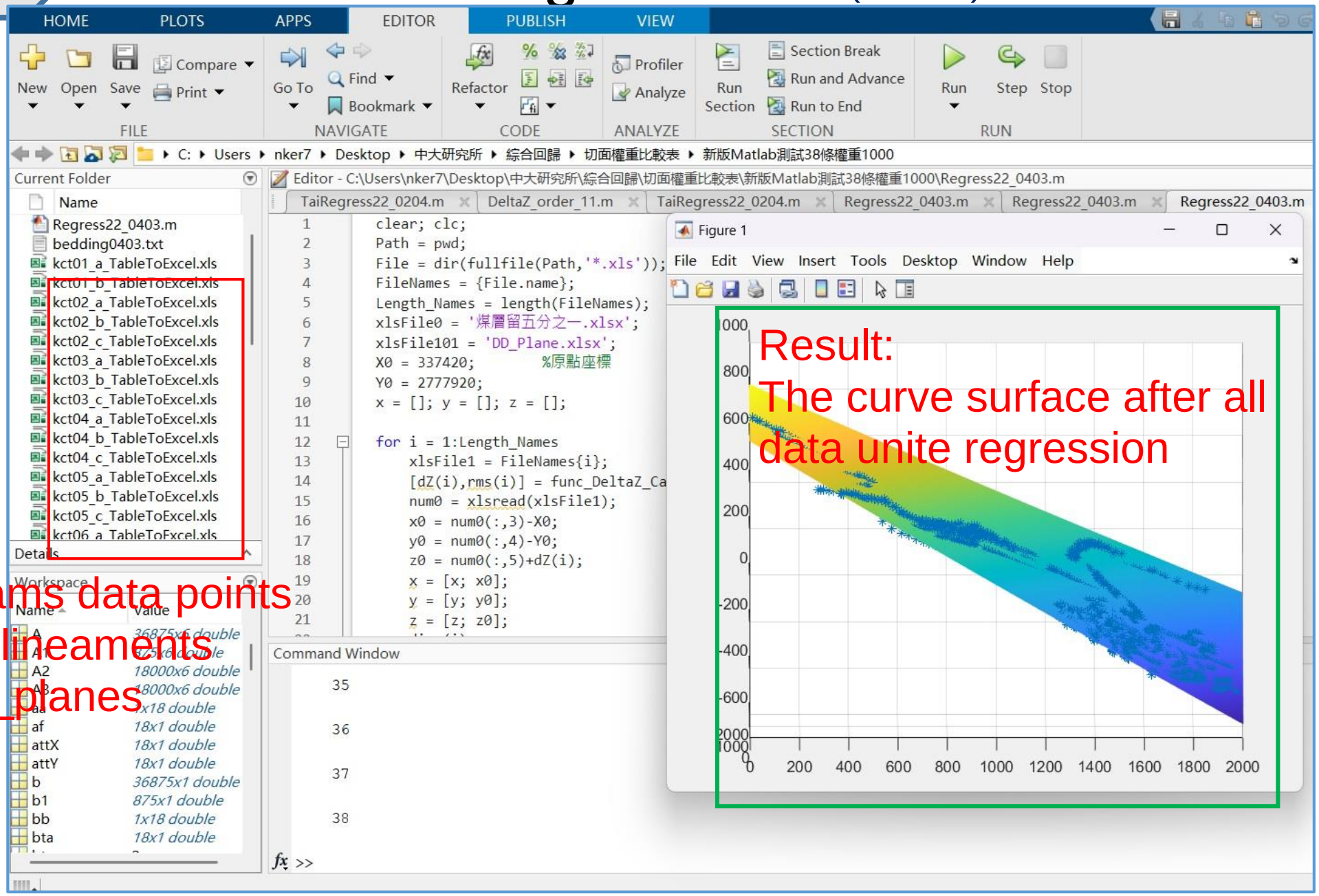
最小平方差(法)

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N}(Z_i - z_i)^2}{N}}$$

Results

Data Processing-MATLAB (葉致翔)

Data:
coal seams data points
Various lineaments
and tan_planes



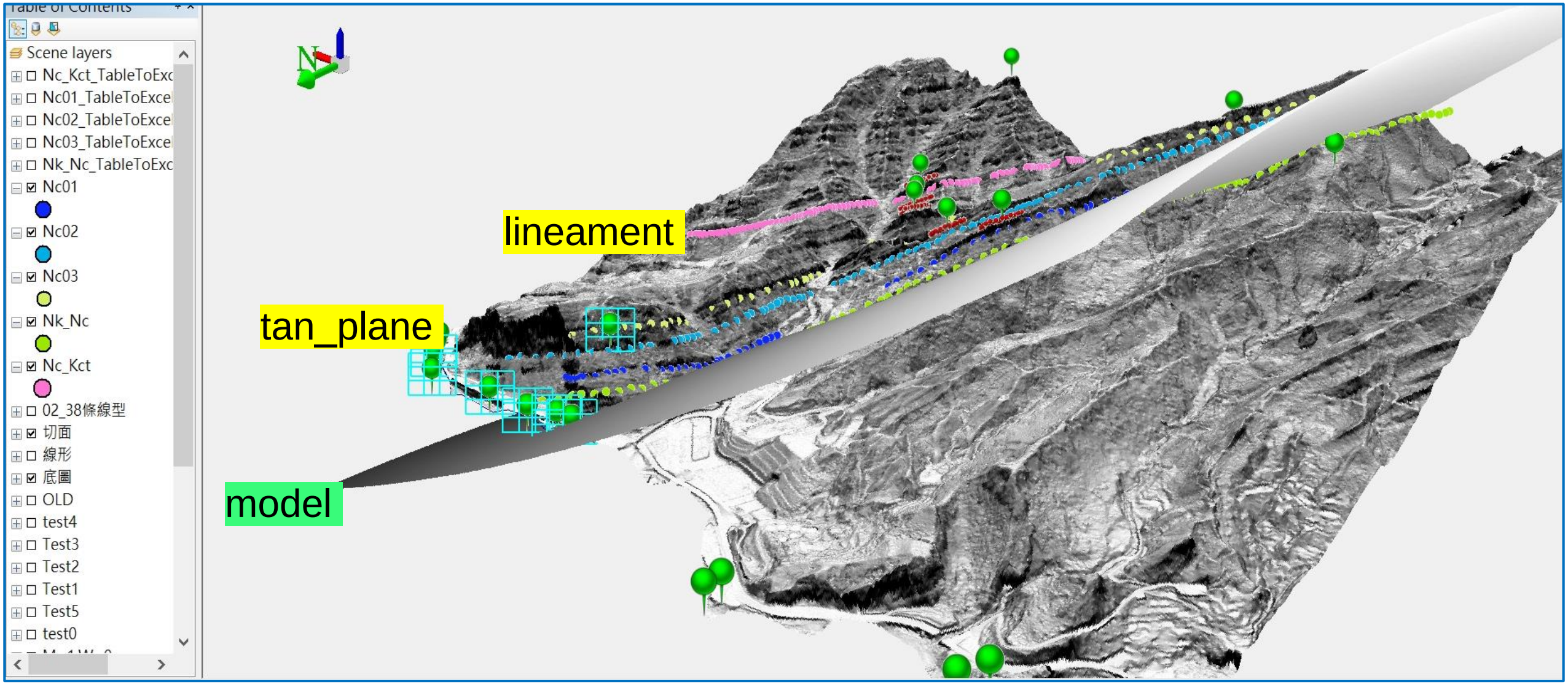
Results

Models and Lineaments contrast

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
量測資料	量測資	量測資料	量測資料	量測資料	量測資料	Test1	Test1	Test1	Test1	Test1	Test1	Test1	Test2	Test2	Test2	Test2	Test2	Test2
NO	類型/名	note	D_Direction	D_strike	Dip	Att_dot	Dot_avera	Model_ Strike	Model_ Dip	weight	magnify	X =	Att_dot2	Dot_avera	Model_ Strike	Model_ Dip	weight	X =
1	平坦面	LiDAR判釋	109.28	19.28	34.12	0.60	0.68	4.91	30.20	1	1000		0.10	0.14	20.38	84.03	1000	
2	平坦面	LiDAR判釋	113.32	23.32	34.93	0.57		6.05	30.39	1	1000	847.939	0.05		20.24	84.33	1000	1.0e+03 *
3	平坦面	LiDAR判釋	112.34	22.34	32.15	0.59		7.71	30.72	1	1000	-0.8565	0.06		20.11	84.72	1000	
4	平坦面	LiDAR判釋	121.06	31.06	46.98	0.32		1.44	36.11	1	1000	0.0806	0.04		29.76	84.93	1000	3.1786
5	平坦面	LiDAR判釋	105.4	15.4	36.4	0.61		0.11	30.37	1	1000	0.0001	0.18		22.67	82.77	1000	-0.0079
6	平坦面	LiDAR判釋	113.7	23.7	38.89	0.55		2.55	31.20	1	1000	0.0001	0.13		25.70	82.11	1000	0.0069
7	shih	施乃慈地質圖	110	20	36	0.56		5.87	30.83	1	1000	-0.0001	0.09		20.94	84.42	1000	0
8	shih	施乃慈地質圖	112	22	41	0.48		4.00	36.80	1	1000		0.23		35.49	83.76	1000	0
9	shih	施乃慈地質圖	116	26	21	0.82		10.29	23.59	1	1000		0.19		6.34	66.77	1000	0
10	shih	施乃慈地質圖	117	27	23	0.63		11.71	33.56	1	1000		0.03		21.84	85.91	1000	
11	LL-1	海邊量測平均	116.8	26.8	17	0.86		4.41	19.43	1	1000		0.07		20.28	73.36	1000	
12	LL-1-5	海邊量測平均	127	37	19	0.84		6.43	19.51	1	1000		0.03		25.09	71.36	1000	
13	LL-1-6	海邊量測平均	127	37	13	0.86		14.35	23.09	1	1000		0.41		35.10	53.03	1000	
14	LL-1-7	海邊量測平均	125	35	14	0.86		13.99	22.77	1	1000		0.37		35.35	55.01	1000	
15	LL-1-8	海邊量測平均	122	32	18	0.84		13.49	22.13	1	1000		0.26		38.03	57.72	1000	
16	LL-1-9	海邊量測平均	126	36	18	0.85		9.11	19.70	10	1000		0.09		33.31	68.16	1000	
17	LL-1-10	海邊量測平均	124	34	18	0.84		11.41	21.14	10	1000		0.17		32.95	63.72	1000	
22	Coal	大富煤層平均	109.2	19.2	31.8	0.63		5.02	30.12	10	1000		0.10		20.22	84.03	1000	

Results

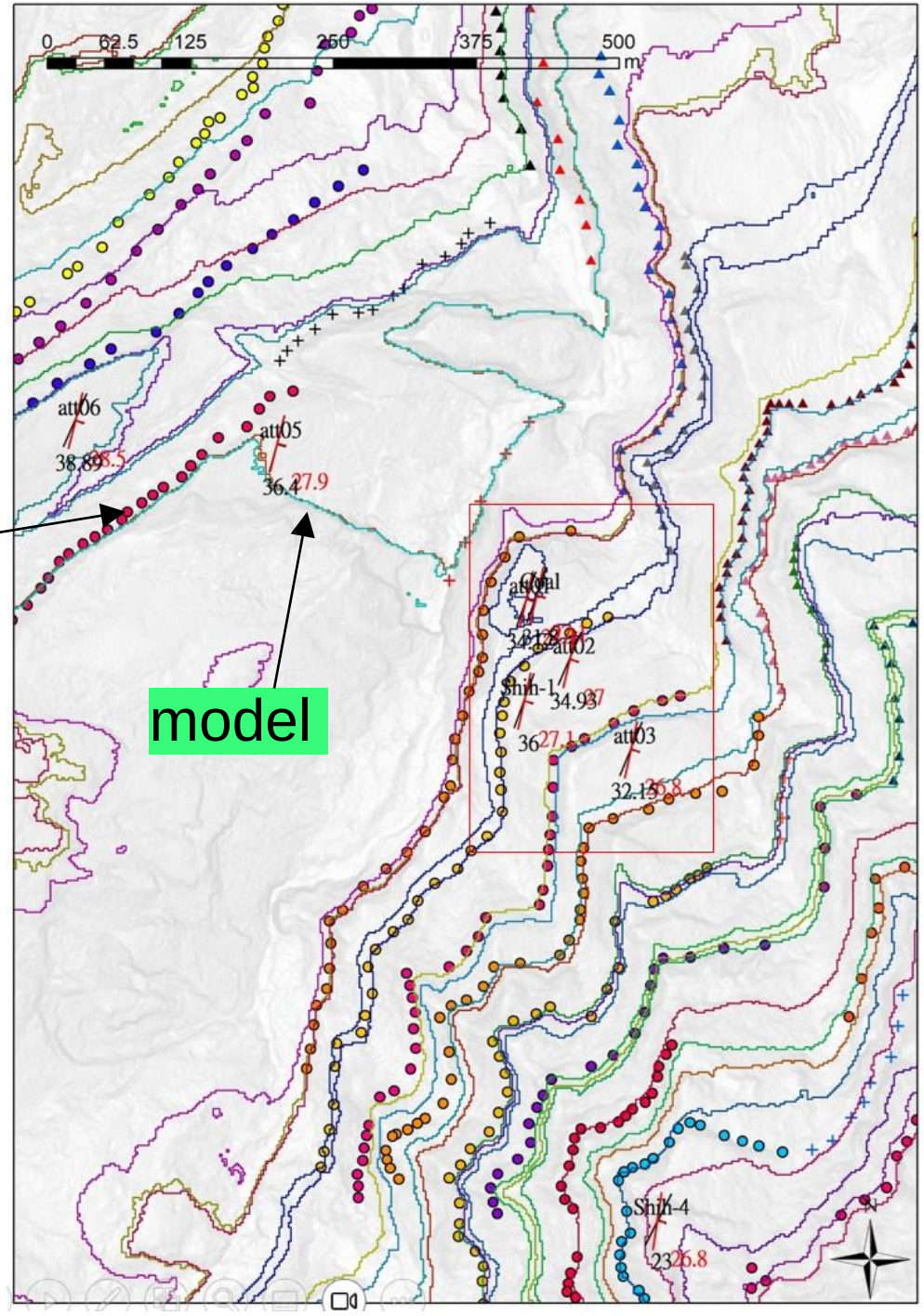
Models and Lineaments contrast-Li-Le(Arcscene)



Results

Models and Lineaments contrast-ArcGis

- lines: Indicat the location of the model in ArcGIS
- dots:Indicat the location of the lineament in ArcGIS

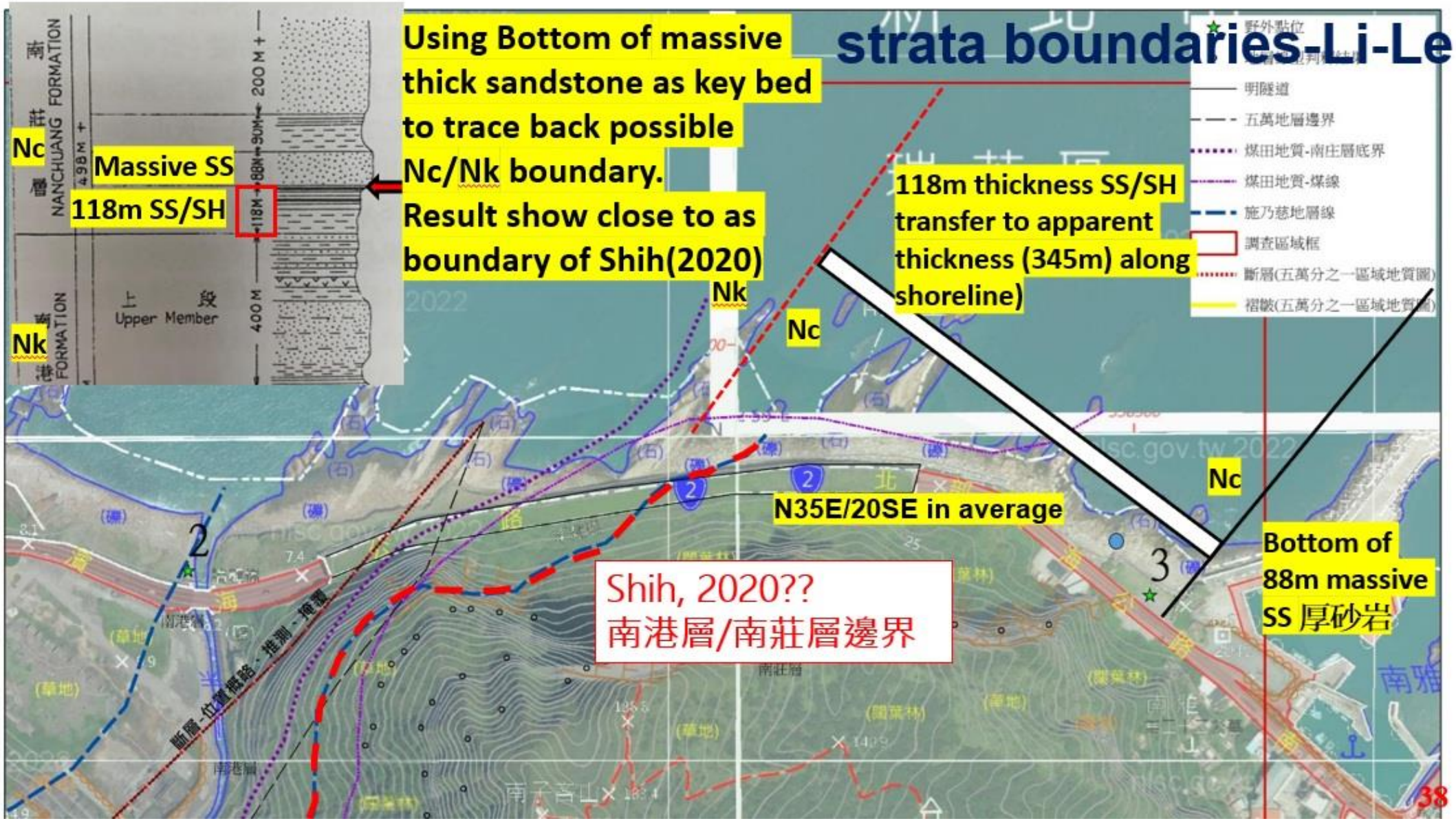


Discussion

- Nk/Nc formation boundaries -Li-Le
- Geological Structure -Sen-Ao
- Model accuracy
- Application

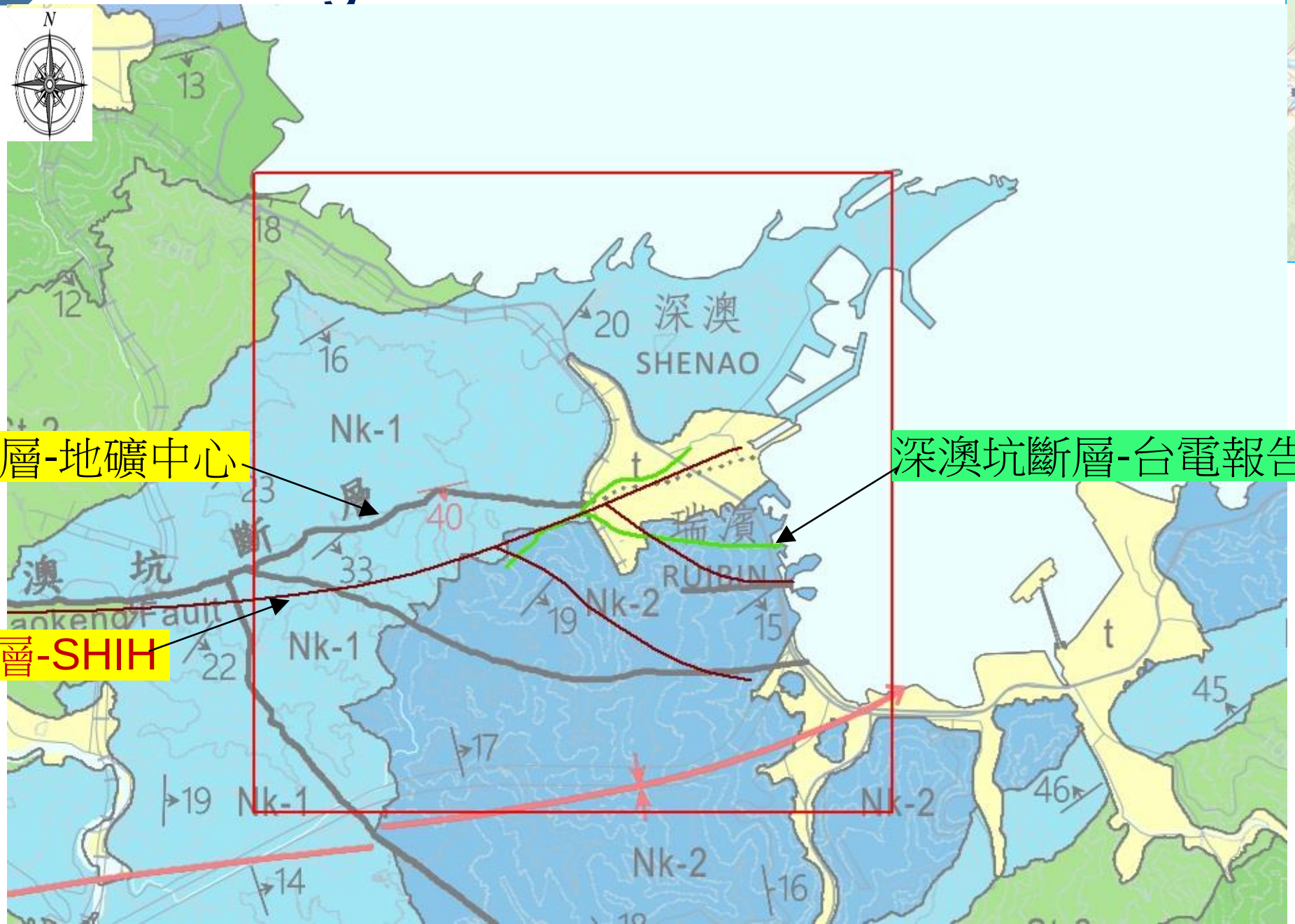
Discussion

strata boundaries-Li-Le



Discussion

Geological Structure-SenAo



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Thanks for your attention