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Galileo Resources Plc

Star Zinc Project

Gravity Forward Modelling along 7 Profiles

19653-HQ-LEL

Report Volume 1/1

K.P. Knupp

9 July 2018

Contents

1. Introduction

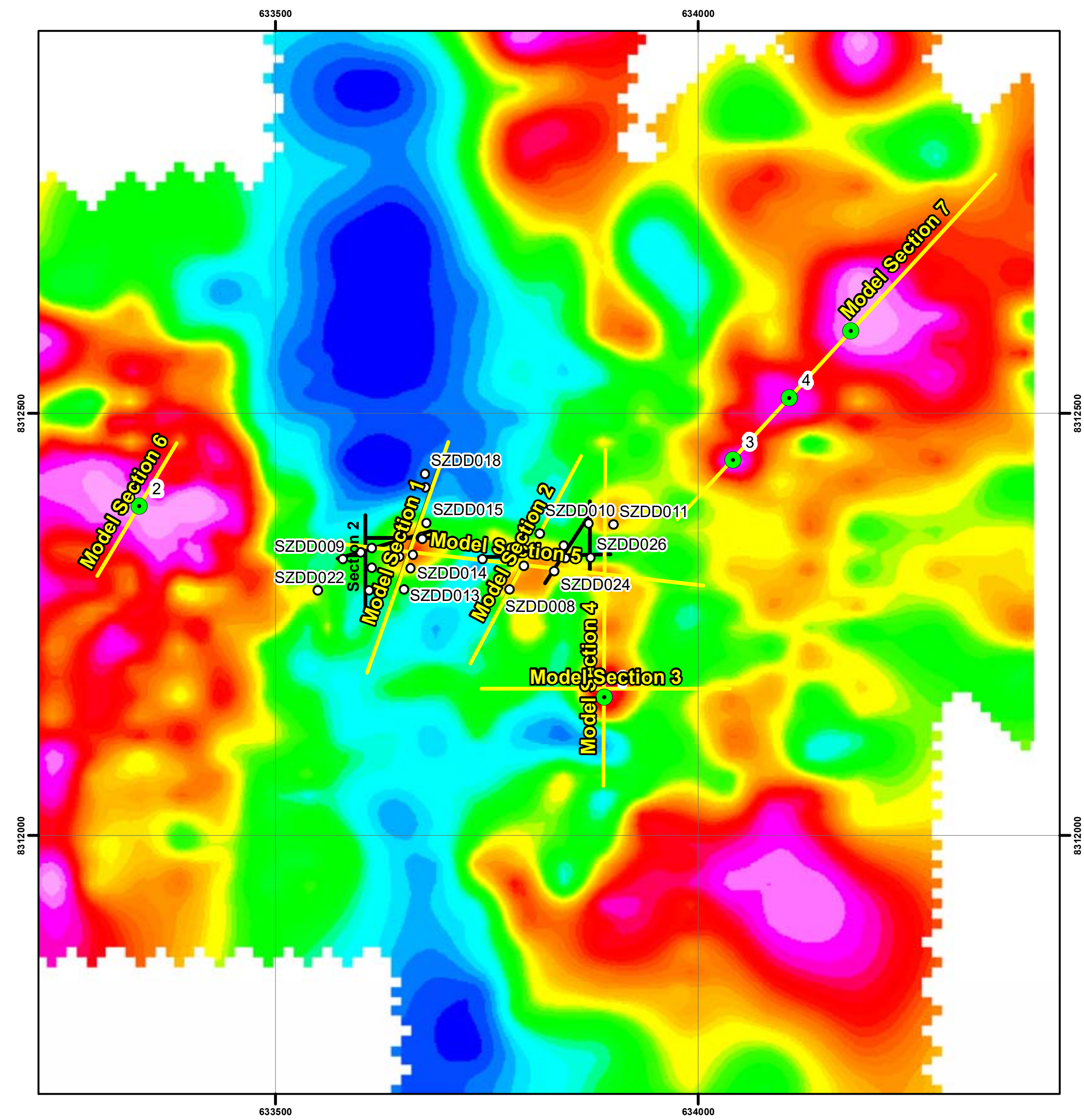
The Star Zinc deposit is a willemite-franklinite zinc deposit located approximately 20 km north-east of Lusaka in the Republic of Zambia and is currently being explored by Galileo Resources Plc (‘Galileo’).

Following recent drilling overseen by GeoQuest Ltd, Zambia (‘GeoQuest’) Earthmaps Consulting CC (‘Earthmaps’) was requested to perform gravity forward modelling over selected profiles across the Star Zinc deposit with the following aims:

i. To test whether the willemite-franklinite zinc mineralisation recently intersected has a response in the gravity data.

ii. To identify any additional zinc exploration targets either beneath the mineralisation already known to date or in the immediate vicinity of the Star Zinc deposit.

Figures 1 and 2 show the available Bouguer Gravity (trend removed) data over the Star Zinc deposit together with geological drill section locations prepared by GeoQuest and the location of traverses modelled and described in this report. Figure 3 shows the digital elevation model surveyed during the course of the gravity survey in 2003 (Gramm C. 2003).



Galileo Resources Plc

Zambia

Star Zinc Prospect

Locality Plan

over

Bouguer Gravity (Trend Removed)

N W E S

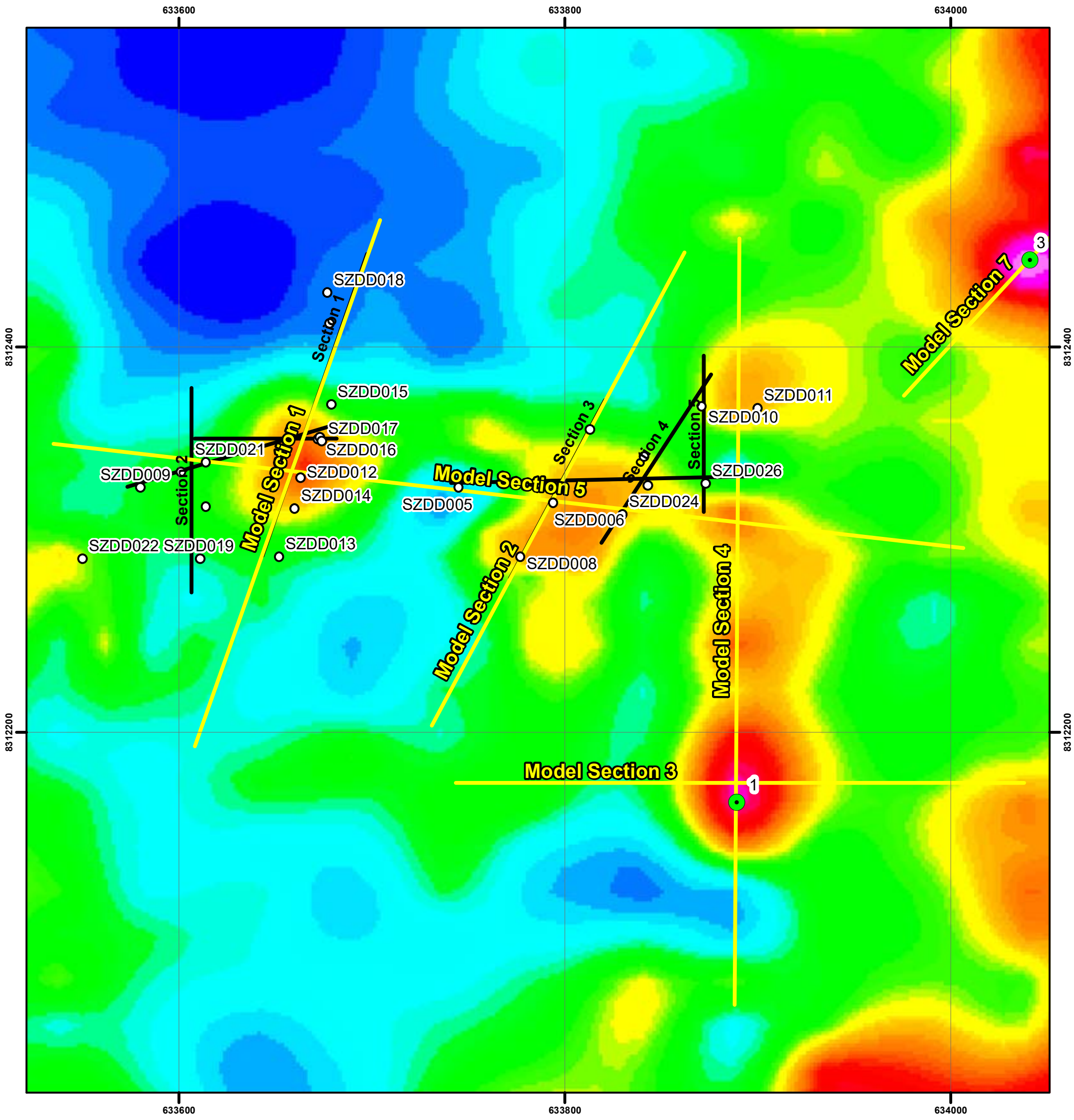
0 50 100 200 300 400 Meters

Legend

- KK Recommended Boreholes
- GRP_Collars_csv.csv Events
- Gravity Model Sections
- GeoQuest Drill Sections

Figure 1

Earthmaps Consulting Jul 2018 Arc1950 UTM35S



Galileo Resources Plc

Zambia

Star Zinc Prospect

Locality Plan

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Bouguer Gravity (Trend Removed)

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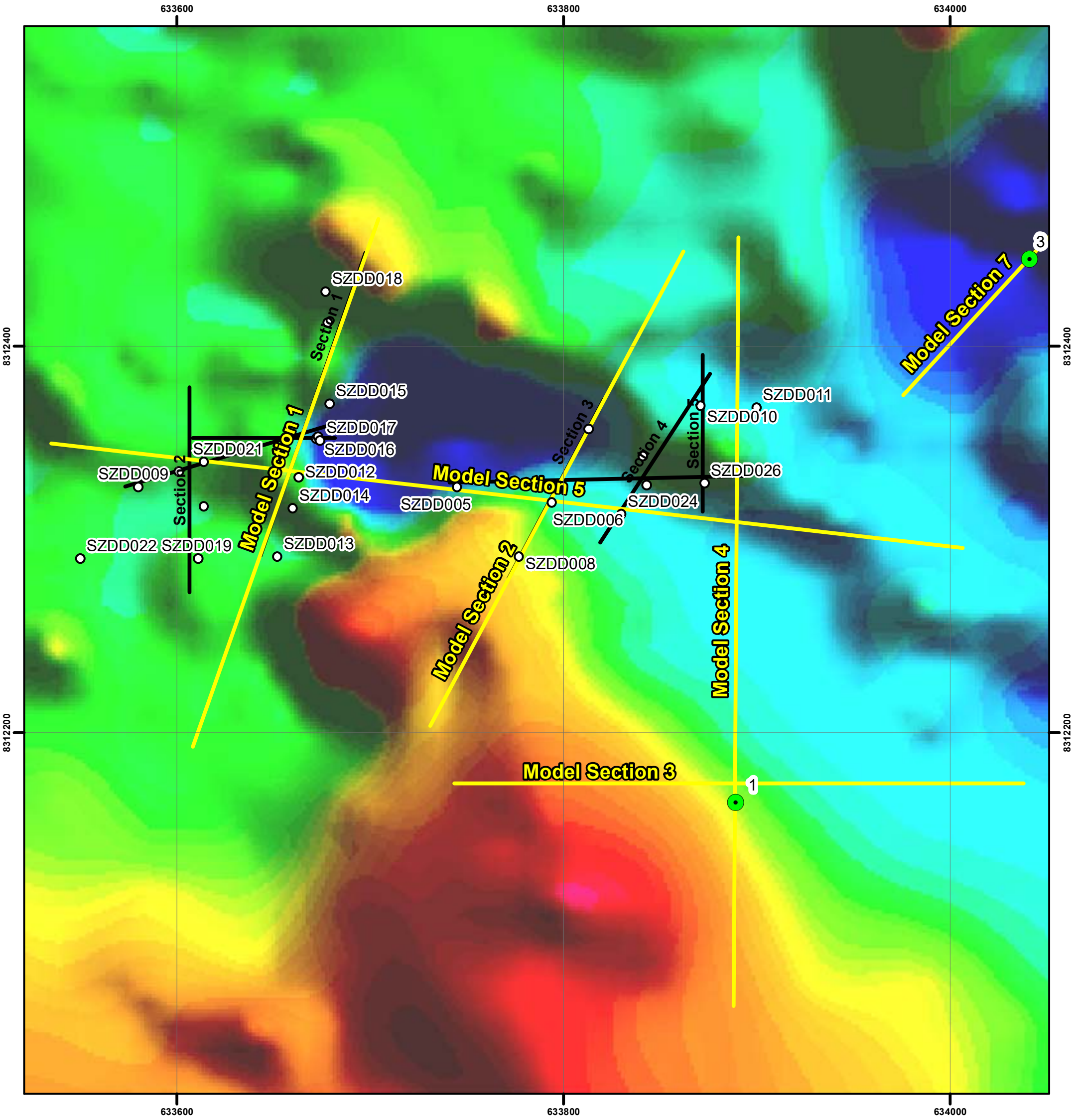
Figure 2

Earthmaps Consulting Jul 2018 Arc1950 UTM35S



Galileo Resources Plc

Zambia

Star Zinc Prospect

Locality Plan

over

Digital Elevation Model

N W E S

0 25 50 100 150
Meters

Legend

- KK Recommended Boreholes
- GRP_Collars_csv.csv Events
- Gravity Model Sections
- GeoQuest Drill Sections

Figure 3

Earthmaps Consulting Jul 2018 Arc1950 UTM35S

2. Geological and Geophysical Data

The following datasets were utilised in this study (Table 1):

Table 1: Geological and geophysical data used in this study

No.	Data	Source	Source / Format
1	Bouguer Gravity and DEM surveyed by Resource Exploration & Development (Pty) on behalf of Avmin Development (Zambia) Ltd in 2003 (Gramm C. 2003)	GeoQuest	Geosoft Grids
2	Drill hole collars and drill sections of drilling undertaken at the Star Zinc deposit between December 2017 and March 2018	GeoQuest	Pdf and csv files
3	Density measurements from drill core at Star Zinc: DB_Density_07052018.xls	GeoQuest	xls file

Drill hole collars were supplied in the Arc1950 UTM35 S projection and therefore all work performed in this report is also projected to Arc1950 UTM35S. Note that the gravity data was apparently surveyed and delivered in the WGS84 UTM35S projection (Gramm C, 2003), however an investigation into the projection of the data confirmed that it was in fact surveyed and delivered in the Arc1950 UTM35S projection.

3. Procedure

3.1. Gravity Forward Modelling

Gravity forward modeling involves the interpreter entering source bodies of pre-defined densities into forward modeling software, calculating their gravity responses, and manually changing the characteristics and shapes of the bodies until a satisfactory fit with the observed data is achieved.

The Bouguer gravity first order trend removed data of Lines 1 - 7 was extracted from the gridded data (Gramm C. 2003) and forward modeled in Encom ModelVision 3D (V 5.00.37). All models used are 2 ½ dimensional, i.e. they have a user determined variable cross section and a finite, user determined strike length.

The reader is reminded that gravity modeling is characterised by a significant degree of ambiguity which is always inherent in gravity (or any potential field) data. This means that an infinite number of different models can cause any single gravity anomaly. However the *limits* of this ambiguity can be determined with the help of gravity forward modeling:

A. Along each section where there was *no* drill control (Model Sections 3, 4, 6 and 7) three models were generated in order to determine the full range of possible gravity source depths:

1. **Shallowest Depth Model** – This is the shallowest gravity model possible before the match between the observed data and the model response begins to deteriorate and a satisfactory fit is no longer possible, or when the gravity target body outcrops.

2. **Intermediate Depth Model** – This is a likely (realistic) model of intermediate depth which provides the best fit of the observed gravity data and also tends to be the geologically most reasonable or feasible.

3. **Deepest Model** – This is the deepest gravity model possible before the fit between observed data and model response begins to deteriorate and/or before density contrasts between the target bodies and background become geologically unreasonable. A maximum density of 4.62 g/cc was chosen for the deepest models as this represents a rock composed of 50% willemite (4.05 g/cc) and 50% hematite (5.18 g/cc) (from density measurements carried out by GeoQuest (DB_Density_7052018.xls)).

4. Barren - This model shows the gravity response of the host rocks only, i.e. with the density contribution of the target bodies turned off.

The actual causative body or bodies are ***very likely to fall somewhere between the shallowest and the deepest models,*** with a likelihood of them being near the ***intermediate model depth***. In the model sections at the end of the report *all three possible models are shown superimposed* to allow visualization of the full range of possible models, together with the response curve of the *Intermediate Depth Model* shown in red.

B. Where drill information existed (Model Sections 1, 2 and 5), three models are presented:

1. **Drill Control** - This model shows the gravity response of the drill intersections as reported by GeoQuest with the sections between boreholes interpolated so as to achieve the best match between the observed and the modelled gravity curves.

2. **Gravity Fit** - This model includes minor modifications to the Drill Control model above, in order to make the calculated gravity response match the observed gravity response.

3. **Barren** – As in A.4. above this model shows the gravity response of the host rocks only, i.e. the density contributions of the target bodies are turned off.

The following **general factors** have an impact on the accuracy of all the presented forward models and must always be borne in mind:

i. Gravity data quality. Models based on gravity data clearly can only be as good as the data they are based on. In this case the data quality is good and instrumental noise levels are low.

ii. The smaller the lateral extent of a gravity anomaly with respect to the survey station spacing, the more uncertain the gravity model and model depth will be due to under-sampling (aliasing) of the anomaly. The gravity station spacing was approximately 25 m in most of the survey area and therefore only small (< 25 m diameter) sources in the uppermost 10 m from surface will be insufficiently sampled (aliased) and therefore cannot be well modelled.

iii. The gravity models assume homogenous densities throughout the causative bodies and sharp, finite edges. This assumption does not often hold in geologic reality and is probably the biggest contributing factor to mismatches between gravity models and the actual sub-surface geology.

iv. The assumed densities and density contrast may be in error. Many rock types have large ranges of densities, particularly so if they are weathered and karsted, and assuming the wrong densities can lead to significant errors in the gravity models.

v. All models are 2 ½ dimensional, i.e. rectangular in plan and rather than rounded/tapered at the ends i.e. they are not fully 3-dimensional. This affects the model accuracy of highly complex anomalies, of bulls-eye shaped or short strike length anomalies more than the model accuracy of long, linear anomalies. Note that hypogene zinc orebodies often have very irregular shapes and are thus often not adequately represented by 2 ½ dimensional bodies.

vi. Interference from shallower sources: Surficial noise such as irregular weathering profiles or karsting can locally give rise to complex interfering gravity anomalies. Such surficial noise significantly contributes to model uncertainties in the Star Zinc Prospect area.

vii. The choice of the regional gravity field along the model traverses may not be optimal and it may therefore affect the accuracy of particularly the deeper parts of the model.

viii. Topography: Complex topography gives rise to noise in gravity data as in valleys there will be an upwards gravitational attraction by the surrounding mountains, interfering with the downward attraction of masses in the subsurface. The Star Zinc gravity data has not been corrected for topographic effects due to the flatness of the area. However it can be expected that gravity stations in the Star Zinc pit will be affected to some degree by topographic effects.

ix. **The total cumulative error (uncertainty) of the models presented is estimated to be +-20% of all depths indicated due to the modeling assumptions listed above.**

NB. It must be emphasized that gravity forward modelling can simulate the *presence or absence* of density contrasts within the subsurface, however it cannot tell *what is causing* these density contrasts. The density contrasts can therefore be due to the presence of density variations within the host rocks, they can be due to local alteration of the host rocks (for instance hydrothermal ferroan dolomitization as at Vazante, Brazil (Krahenbuhl R. and Hitzman M.)), or they can be due to the presence of zinc mineralisation, - or they can be due to a combination of all three. However gravity can, in simple geological environments and where ores have strong gravity contrast with the host rocks, distinguish more prospective from less prospective areas.

4. Results

The model sections are included at the back of the report and are discussed in the sections below:

4.1. Line 1: Gravity Model 1: Drill Control

This model section follows drill section 1 and shows the following:

There is a good match between the gravity model response as controlled by drill intersections and the measured gravity, except for an apparent along-line off-set between the model and the actual gravity responses. However the shape of the ore intersection as well as the density contrast between host rock and ore (2.84 g/cc and 3.7 g/cc respectively) give rise to the correct gravity response both in terms of anomaly amplitude and shape.

4.2. Line 1: Gravity Model 2: Gravity Fit

This model shows that minor modifications to the 'Drill Control' model can result in a very close fit of the observed gravity data. This strongly suggests that along Line 1 the gravity high is caused by the presence of zinc ore, and that only small differences exist between the drill intersections and the actual density distribution in the subsurface. These small differences can easily be accounted for by in-homogenous density distribution within the ore, and off-section densities contributing to the gravity measured along Line 1. Notably this model also demonstrates that there is no room in the gravity response for an additional, dense gravity target beneath the drill intersections. In other words, this drill section is considered drilled to sufficient depth.

4.3. Line 1: Gravity Model 3: Barren

In this model the gravity effect of the ore is turned off and only the response of the host rocks remains. The total gravity response of the host rocks accounts for about 0.1 mgal along the section, whereas the main gravity high of 0.19 mgal is no longer accounted for. This demonstrates that the zinc ore body is the main cause of the gravity high in Line 1, and had one targeted the gravity high one would have discovered the zinc mineralisation. Moreover, this model demonstrates that there is no significant, unaccounted gravity anomaly left that could indicate another, blind ore body beneath the line of drilling.

4.4. Line 2: Gravity Model 1: Drill Control

Line 2 is not ideally positioned with respect to the gravity as it runs along the edge of a gravity anomaly. However it was modelled nevertheless as it follows Drill Section 3 where drill control is good. Modelling the drill intersections along Line 2 shows that a partial fit is achieved between the model curve and the observed gravity response.

4.5. Line 2: Gravity Model 2: Gravity Fit

This models shows that if the ore body is extended further and thicker south-west of borehole SZDD004 a good fit with the observed gravity can be achieved. It seems quite possible that off-line ore exists to the SE and contributes to the gravity, particularly between SZDD006 and SZDD008. A shallow, low density karst adequately explains the local gravity low NE of SZDD004. With this model the observed gravity does not allow for any additional ore beneath the line of drilling.

4.6. Line 2: Gravity Model 3: Barren

Model 3 demonstrates that the variations in the host rock only account for about 20% of the gravity anomaly, and therefore the zinc ore is needed to account for the remaining 80% of the gravity anomaly. Or put differently: Had one targeted the gravity high one would have discovered the zinc ore.

4.7. Line 3: Gravity Models: All Depths

Line 3 runs E-W across a prominent 0.2 mgal anomaly south-east of the Star Zinc pit and has not been drill tested. Separately modelling the shallowest, intermediate and deepest possible source bodies hosted in dolomitic limestone overlying shale returns a source body with a depth to top ranging from 2 m to 25 m. The prominent gravity low on its western side is best modelled by a low density fault zone.

4.8. Line 3: Gravity Model: Barren

Turning the target body off leaves only about 20% of the gravity anomaly on account of the host rock. Therefore there has to be a significant amount of material with a density substantially higher than the 2.84 g/cc host rock to account for this gravity anomaly. This could be barren, ferric alteration of the bedrock, but it could also be zinc ore.

4.9. Line 4: Gravity Models: All Depths

Line 4 runs N-S along the string of three gravity highs, the southern most of which has been modelled along Line 3. The southern, strongest of the gravity highs models as in Line 3, while the gravity highs to the north model as smaller, and shallower bodies in a dolomitic-limestone type host rock with a density assumed to be 2.84 g/cc. Borehole SZDD011 has been drilled near the edge of dense bedrock bodies and has not intersected any mineralisation (Lucas H. pers com), however it is not ideally positioned to test this particular gravity high.

A borehole is recommended at the position indicated to test the strongest of this string of gravity highs, with a maximum depth of 40 m.

4.10. Line 4: Gravity Model: Barren

This model shows the host rock response only and demonstrates that only half of the gravity response (peak to trough) is accounted for by the host rocks. There has to be significant excess mass to account for the remainder of the gravity highs.

4.11. Line 5: Gravity Model 1: Drill Control

Line 5 is an E-W long section across the Star Zinc Prospect and covers the areas east and west of the pit as well as the pit itself. Drill control along this section results in a gravity model that accounts for most of the observed gravity response.

4.12. Line 5: Gravity Model 2: Gravity Fit

With minor modifications to the Drill Control Model 1 (4.11. above) a good account of the observed gravity can be achieved.

4.13. Line 5: Gravity Model 3: Gravity Fit

Model 3 shows the pit position indicated and the model has been adjusted to account for ore outcrops at the western as well as the eastern ends of the pit (H. Lucas pers com). The match of the observed gravity again is good. Note that the strong gravity low in the pit can be modelled by a low density fault zone. However one needs to remember that this gravity low can in part be caused by topographic effects caused by the pit shape itself. Even allowing for some uncertainty in the gravity data in the pit, there is little if any room in the gravity response for additional deep zinc targets such as a feeder zone.

4.14. Line 5: Gravity Model 4: Barren

Turning off the gravity response of the target bodies and leaving only the response of the host rocks shows that the 80 -90% of the observed peak to trough gravity responses are caused by dense bedrock greater than 2.84 g/cc in density, while only 10-20% of the gravity response is caused by the bedrock itself.

4.15. Line 6: Gravity Models: All Depths

Line 6 models a 0.15 mgal strong, linear gravity anomaly to the west of the Star Zinc Prospect. A homogenous dolomitic limestone host has been chosen as in this part of the prospect the background gravity is higher than at Star Zinc itself.

A dense body in the center of the line matches the gravity response and models to have a possible depth-to-top range of between 1 m and 20 m from surface. Borehole 2 is recommended at the position indicated on the section to test this gravity anomaly for possible zinc mineralisation.

4.16. Line 6: Gravity Model: Barren

This model demonstrates that most of the gravity response must originate from a dense body in the center of the line as it in all likelihood cannot alone be caused by the host rock.

4.17. Line 7: Gravity Models: All Depths

Line 7 lastly models a string of 3 strong gravity highs to the N-E of the Star Zinc prospect. Shallowest, intermediate and deepest models for each of these three gravity highs are shown in the model figure. Maximum depths-to-tops range from 25 m in the south to 35 m in the north where the gravity anomaly is broader and smoother. Three boreholes are indicated on this section to test each of the three gravity highs for zinc mineralisation.

4.18. Line 7: Gravity Model: Barren

The 'Barren' model demonstrates that between 5 and 20% of the gravity amplitude of the three gravity highs can be accounted for by variations in the shape of the host rock. Significant additional masses should therefore be present to account for the remainder of the observed gravity signal.

5. Conclusion

Gravity surveying along Lines 1 to 7 at the Star Zinc Prospect has shown:

1. Along three drill sections where zinc ore has been intersected, the gravity anomalies reflect the ore distribution quite well. This gives encouragement to use gravity as one of the tools to target additional zinc mineralisation in the area.

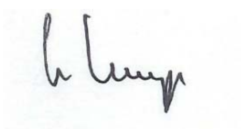
2. Along the three drill sections that were modelled, the gravity data does not indicate any significant drill targets below the depths drilled to date. It appears therefore that the footwall shales are barren. That said, the gravity data inside the historic pit is not very reliable due to topographic noise, and drilling in the pit itself may well be warranted on grounds other than the gravity.

3. Five borehole positions are presented to test gravity highs to the west, north-east and south-east of the Star Zinc Prospect for zinc mineralisation. It is recommended to drill these boreholes first and then re-assess the results, before embarking on further targeting based on gravity.

4. When drilling gravity targets other than the ones presented, care should be taken to sight the boreholes on the centers of the gravity anomalies using the Bouguer Gravity: Trend Removed data and not the straight Bouguer Gravity, as the latter will result in drilling off the center of the residual gravity anomalies which is inconclusive and is furthermore hard to reconcile with the gravity. Using the Bouguer Gravity itself allows the testing of very deep gravity targets which however might turn out to be un-economic.

5. Galileo Resources and GeoQuest are complimented for their diligent density measurements on drill core. This has resulted in a robust rock density database for the Star Zinc Prospect which is indispensable for gravity modelling. It is recommended that density measurements are continued on drill core in the future, particularly once drilling steps away from the Star Zinc Prospect itself. Density measurements should be reconciled with the modeling presented here to assess the modelling and to provide better modelling constraints in the future.

Respectfully submitted,



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6. Acknowledgements

The author wishes to thank Galileo Resources Plc as well as GeoQuest for the opportunity to carry out this modelling work. In particular Mr. Harris Lucas of GeoQuest is thanked for kindly supplying all the ancillary data and supporting insight and information without which this study would not have been possible.

7. References

Gramm C. Star Zinc Grid, 2003 Gravity Survey. Acquisition and Processing Report including a preliminary Interpretation. Internal report for Avmin Developlment (Zambia) Ltd, Resource Exploration and Development (Pty) Ltd. 2003.

Krahenbuhl R. A and Hitzmann M, date unknown. Geophysical modelling of two willemite deposits, Vazante (Brazil) and Beltana (Australia). Source and date unknown.

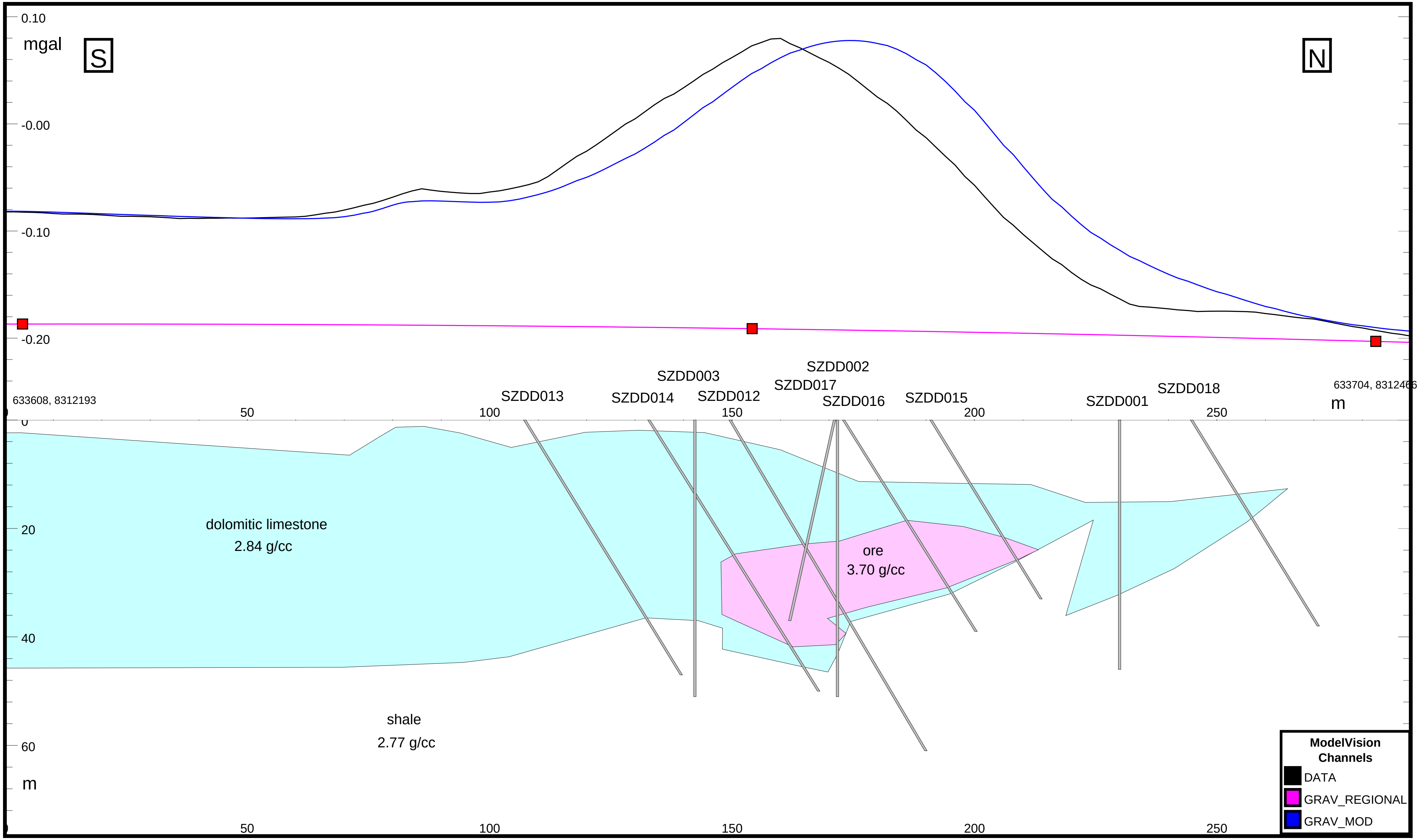
GeoQuest. Date unknown. A brief summary of some key geological observations from the recently completed diamond drilling campaign at the Star Zinc Deposit: December 2017 – March 2018. Internal Report prepared by GeoQuest.

Model Sections

Star Zinc

Resource Exploration and Development Gravity

Star Zinc Deposit: Line 1 Gravity Model 1: Drill Control



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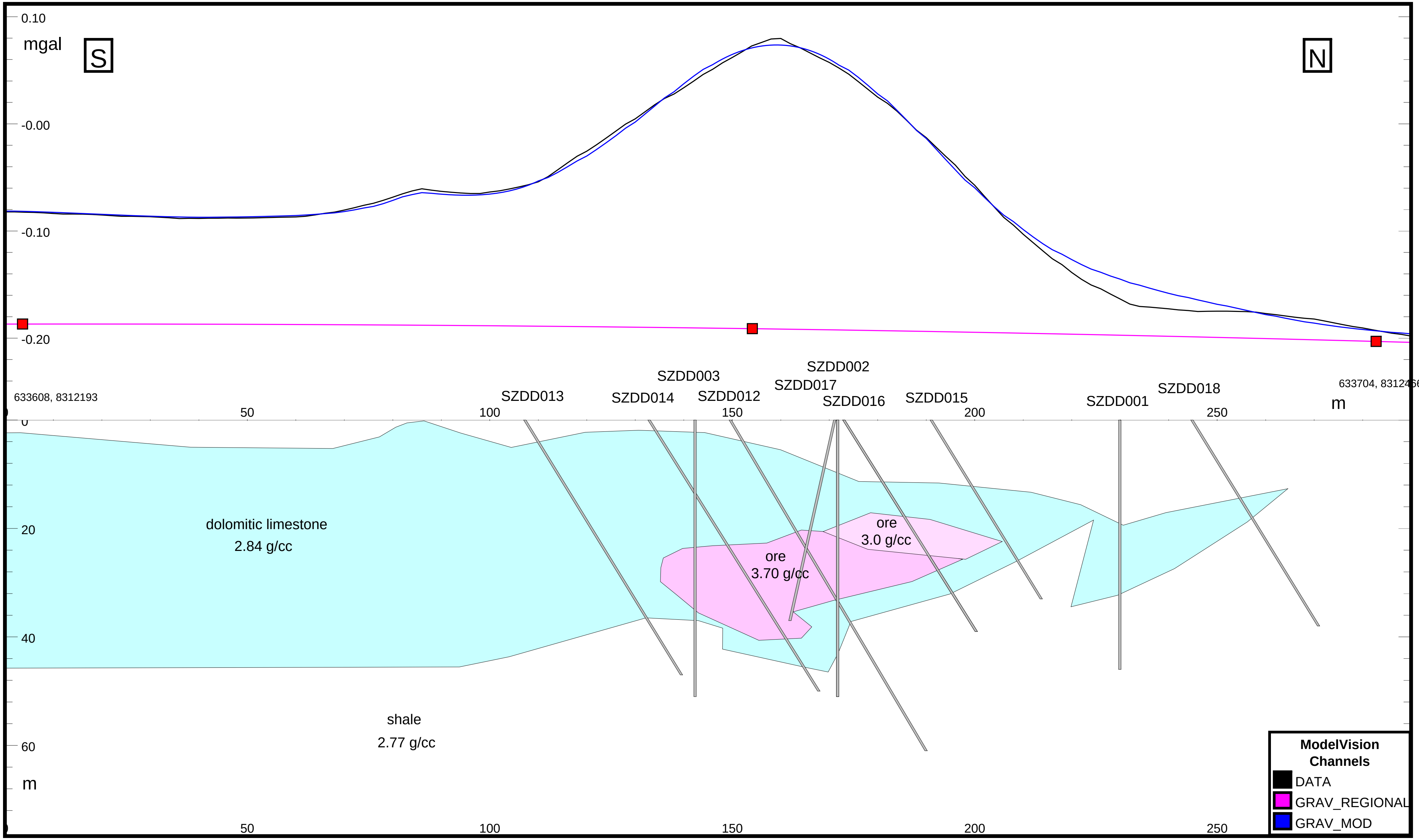
Star Zinc

Resource Exploration and Development Gravity

Star Zinc Deposit: Line 1 Gravity Model 2: Gravity Fit



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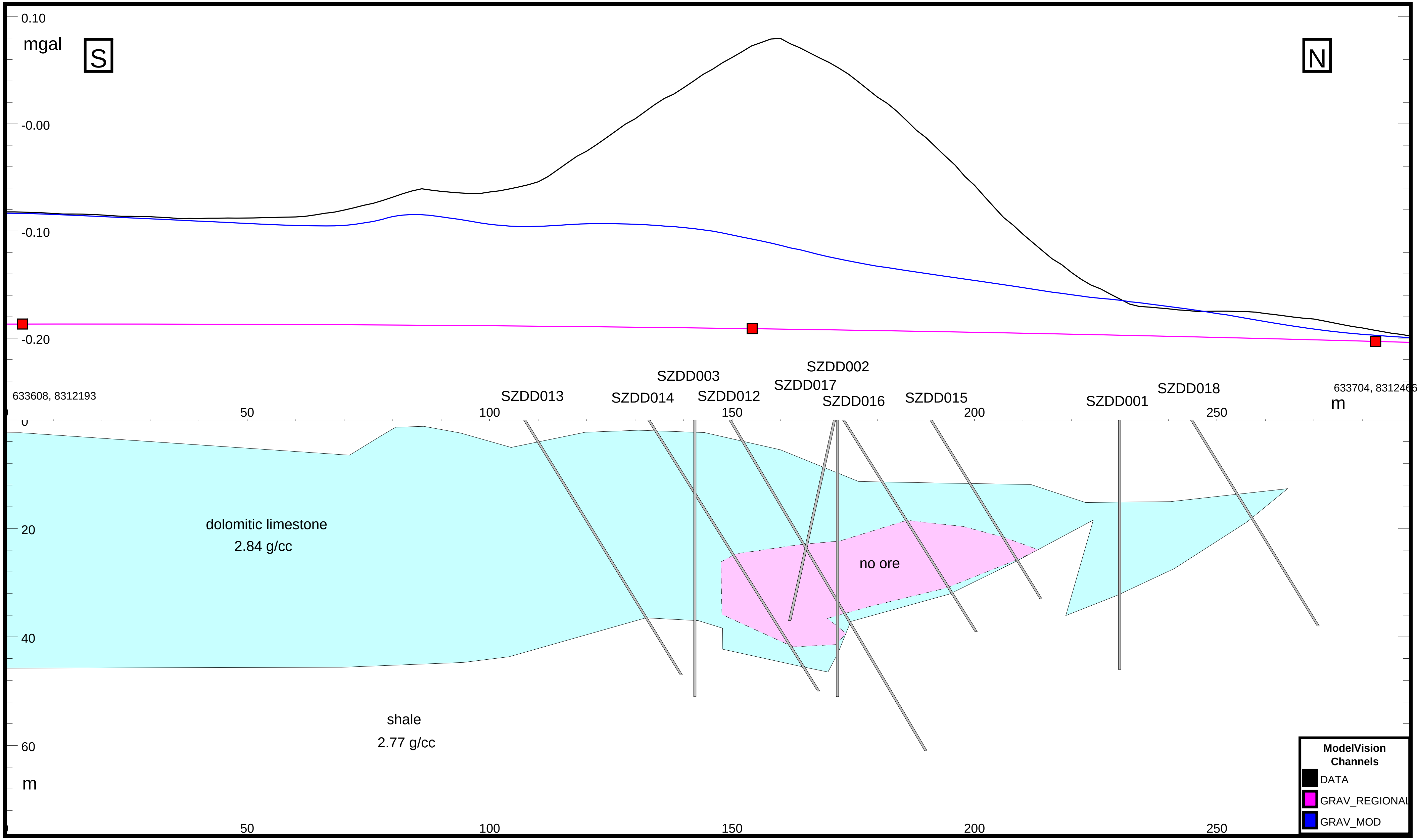
Star Zinc

Resource Exploration and Development Gravity

Star Zinc Deposit: Line 1 Gravity Model 3: Barren



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Resource Exploration and Development Gravity

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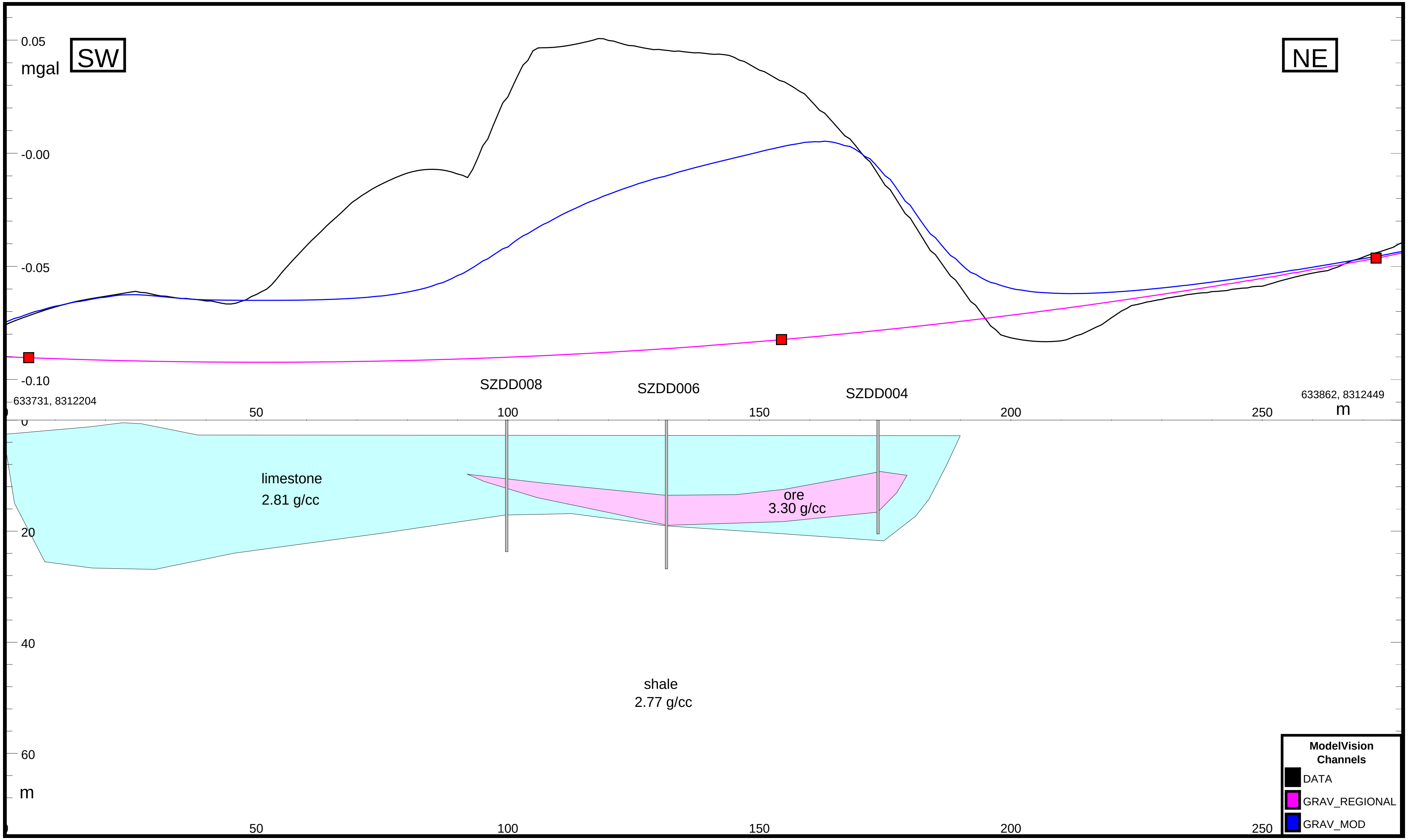

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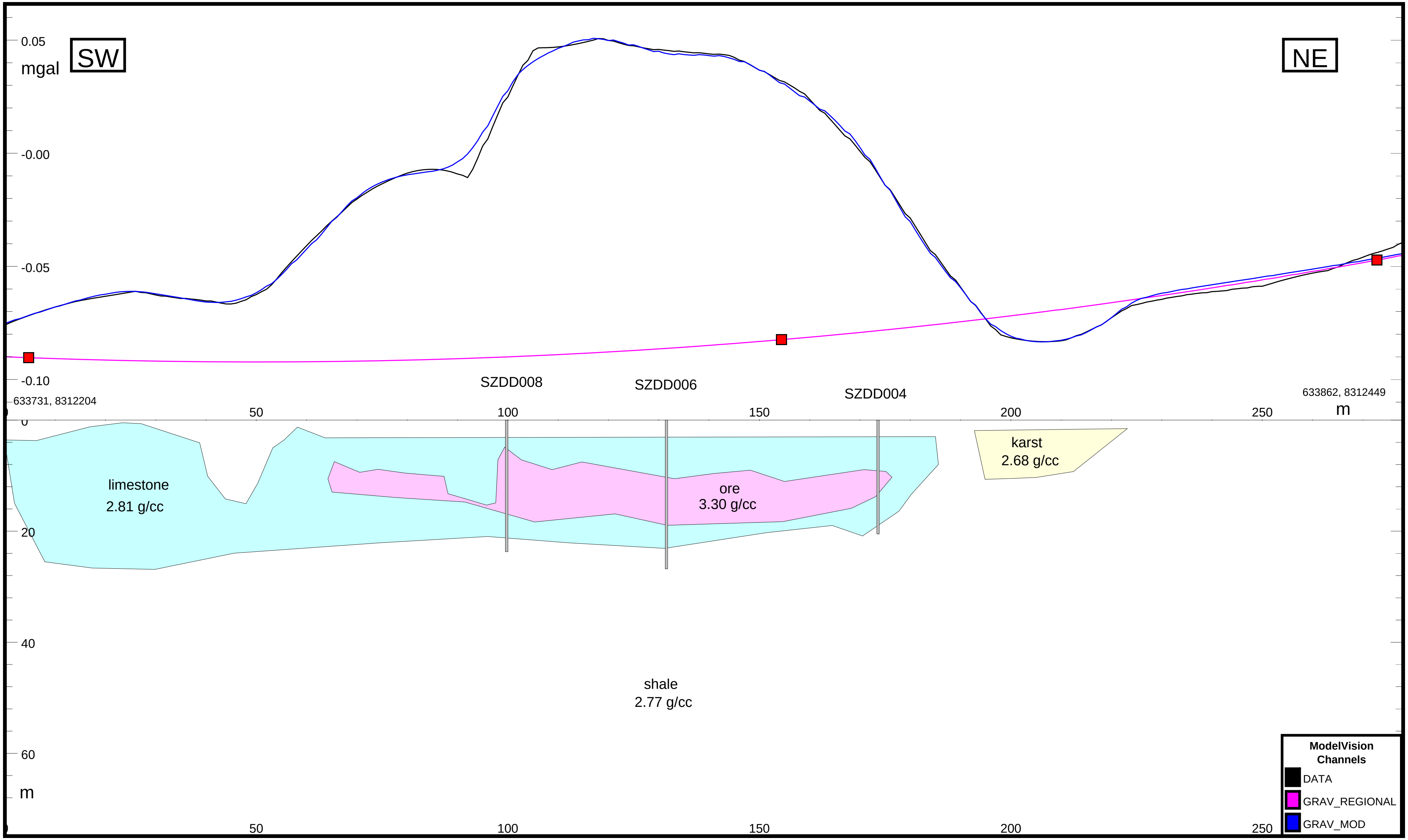

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Resource Exploration and Development Gravity

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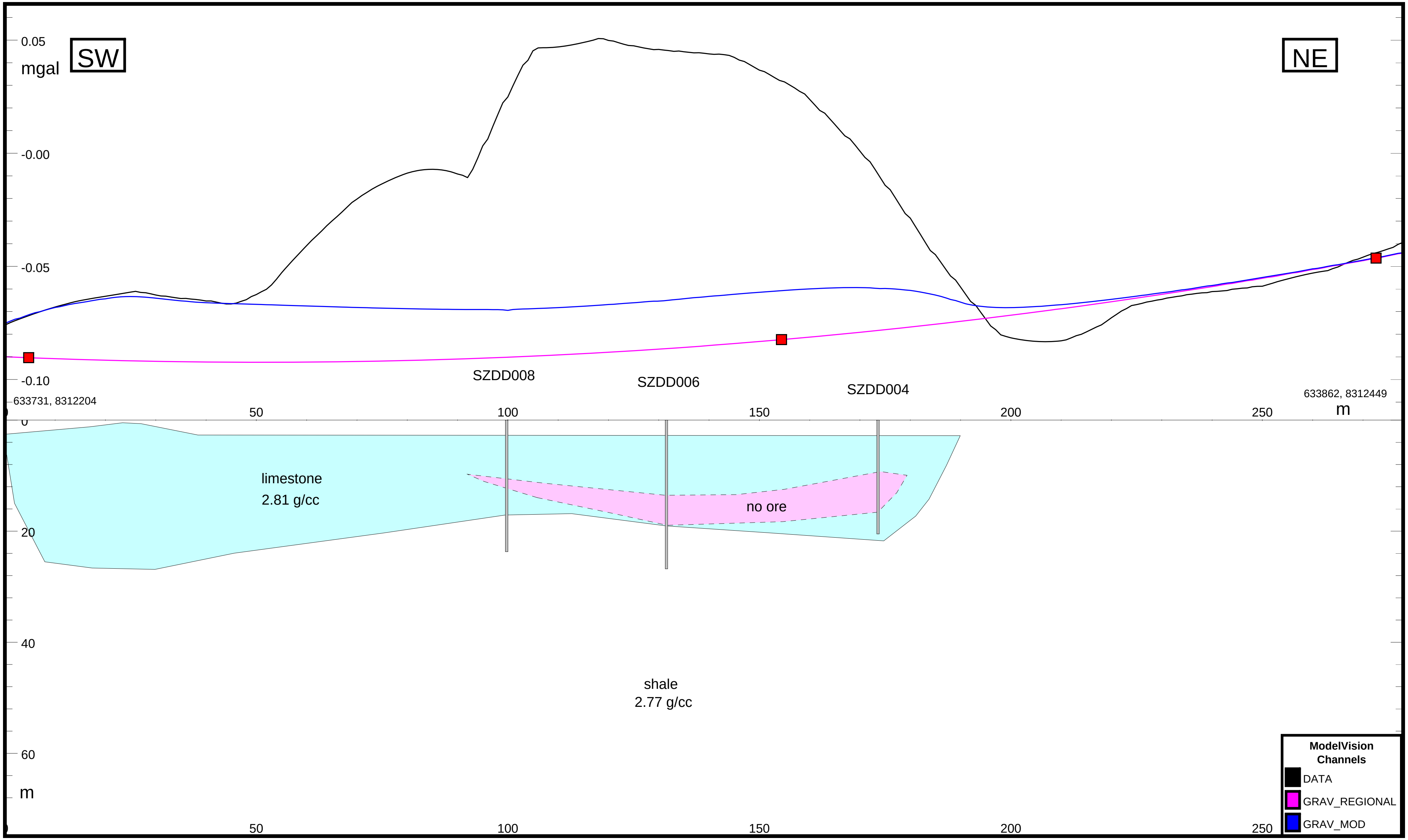

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Resource Exploration and Development Gravity

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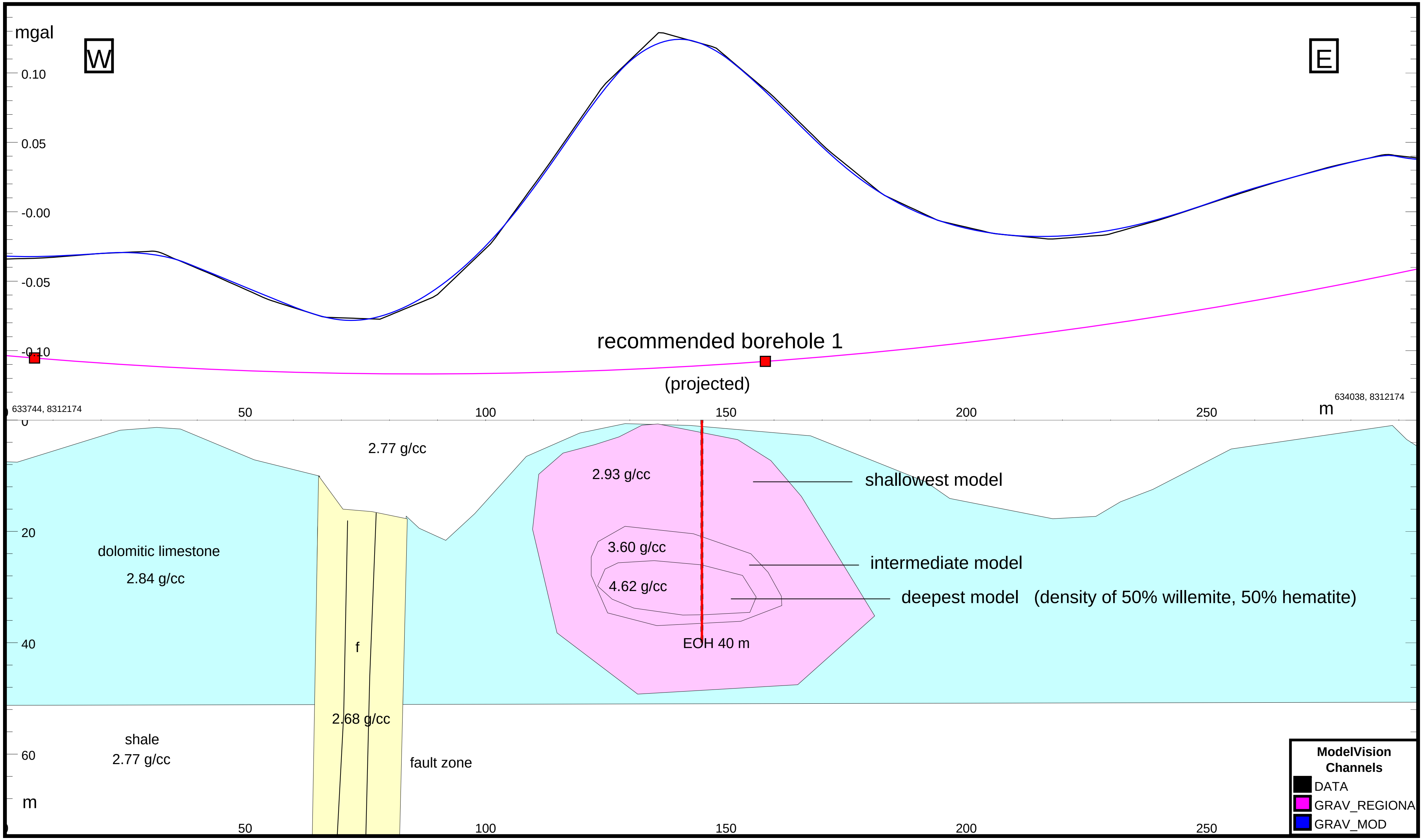

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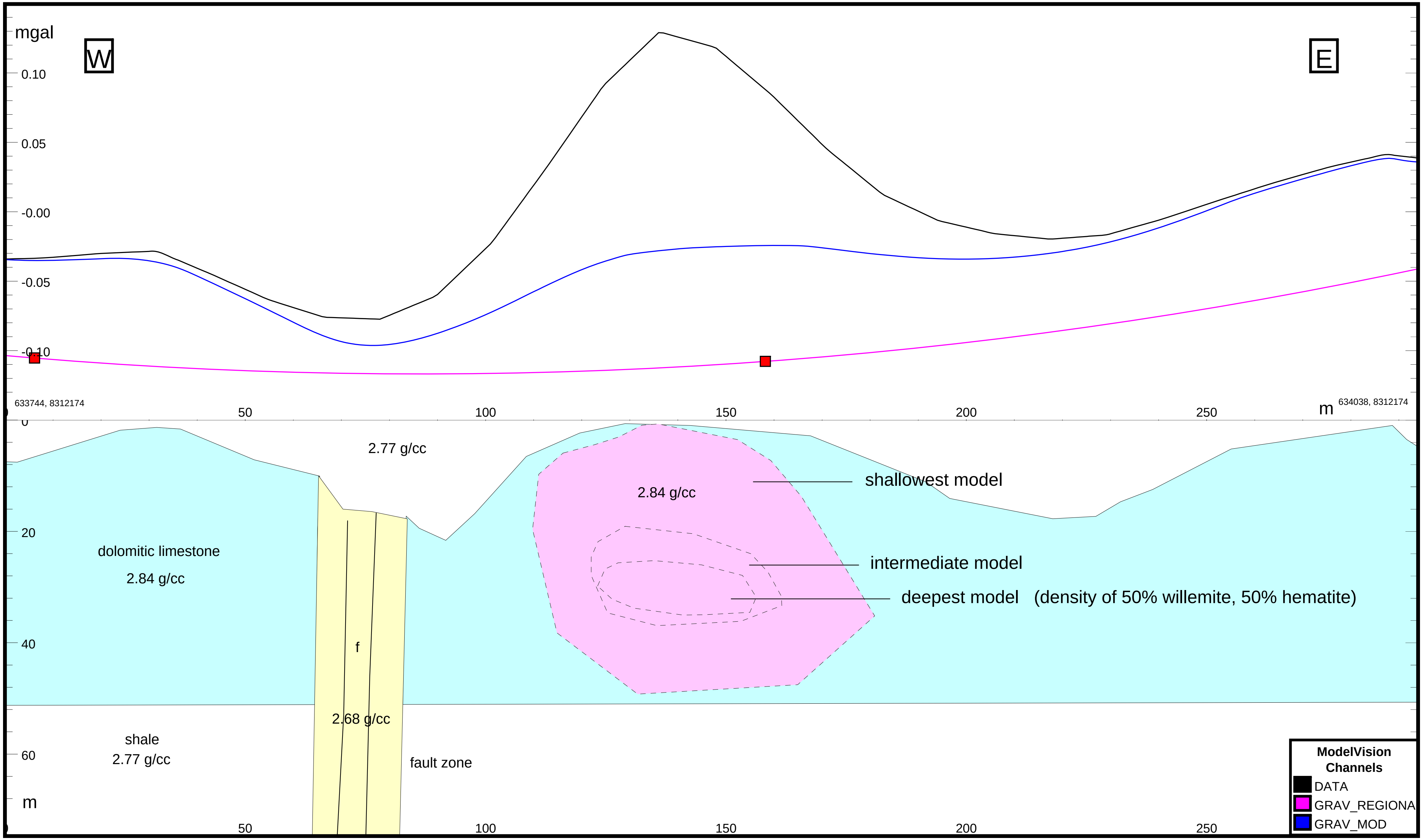
Resource Exploration and Development Gravity

Star Zinc Deposit: Line 3 Gravity Model: Barren



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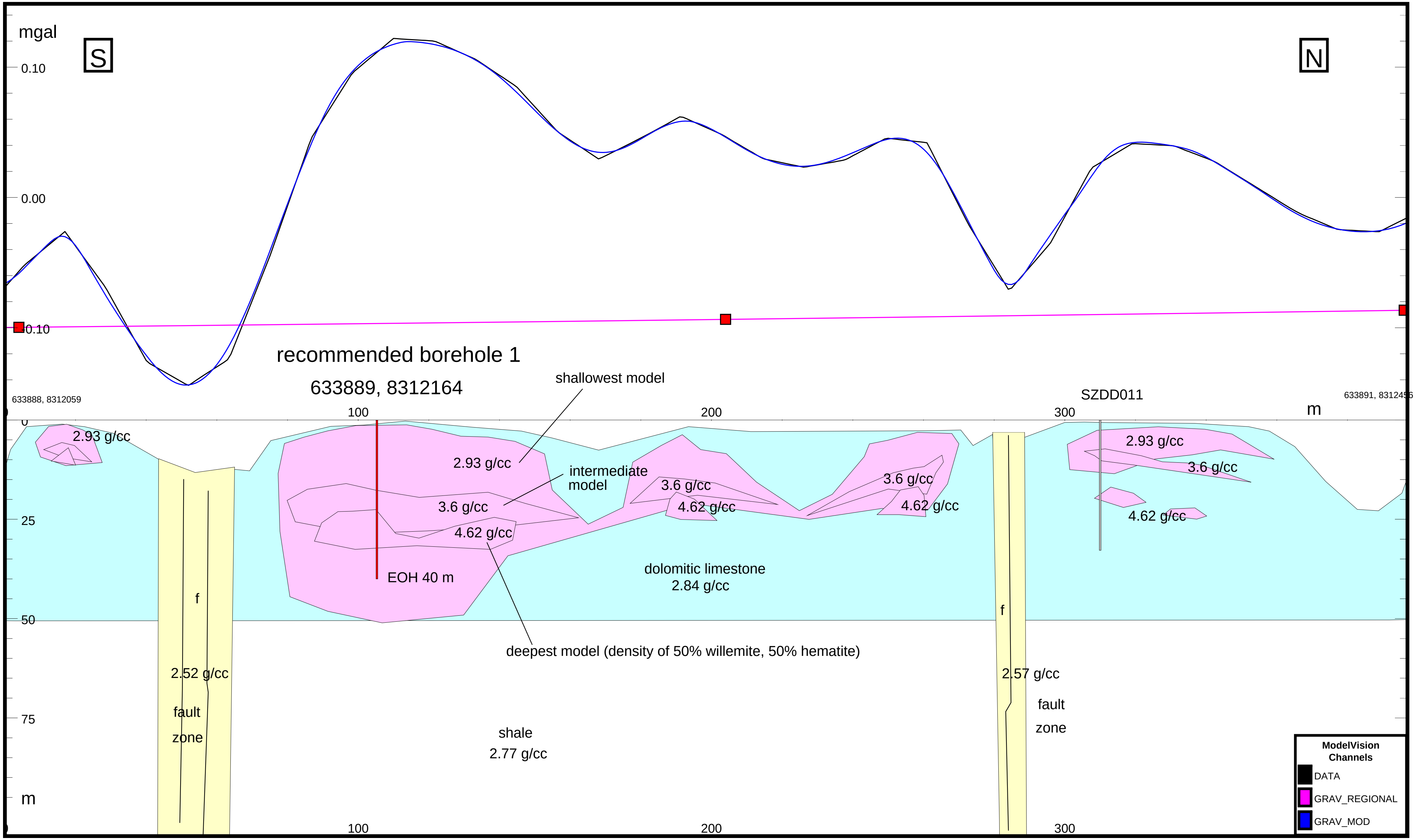
Resource Exporation and Development Gravity

Star Zinc Deposit: Line 4 Gravity Models: All Depths



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Resource Exporation and Development Gravity

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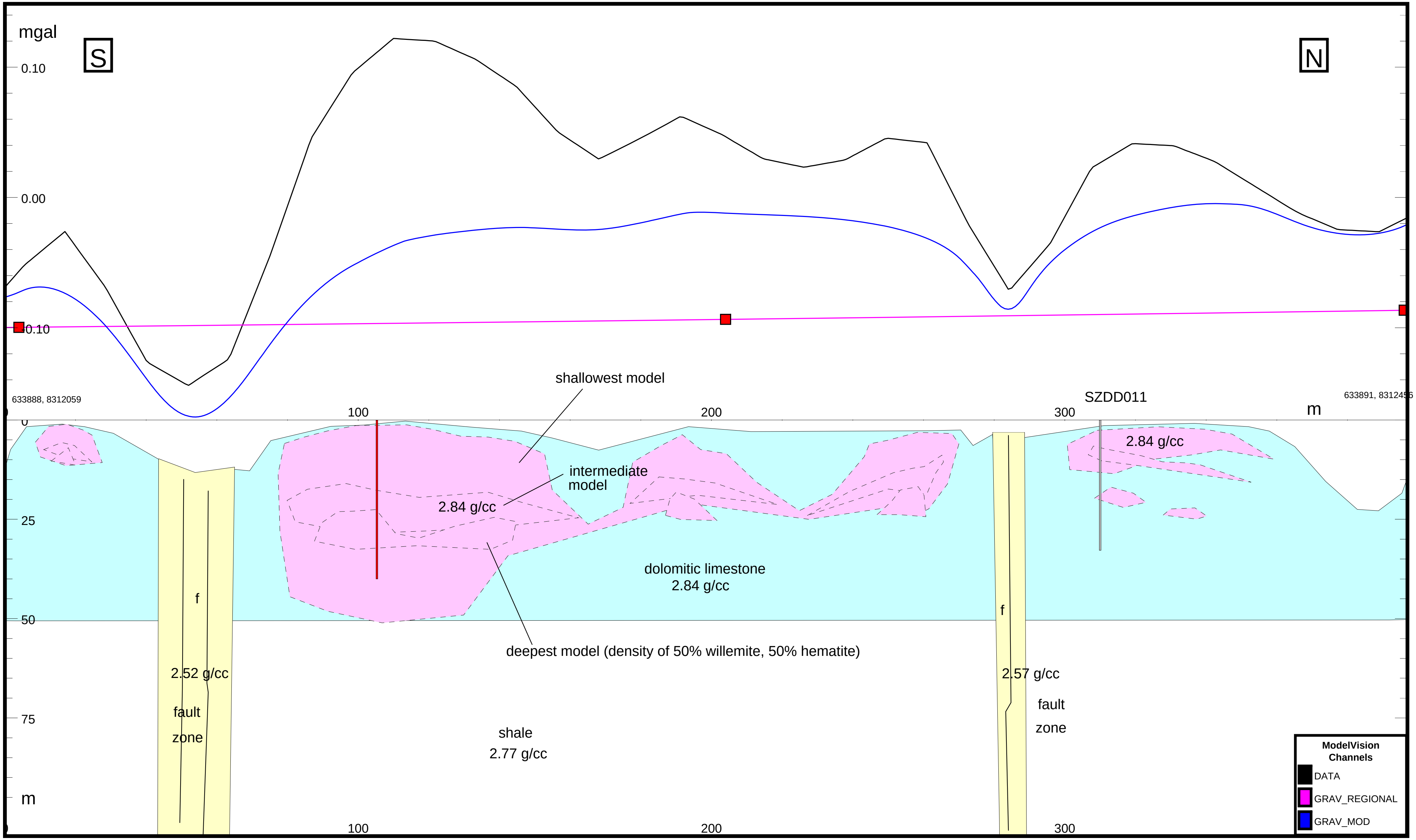

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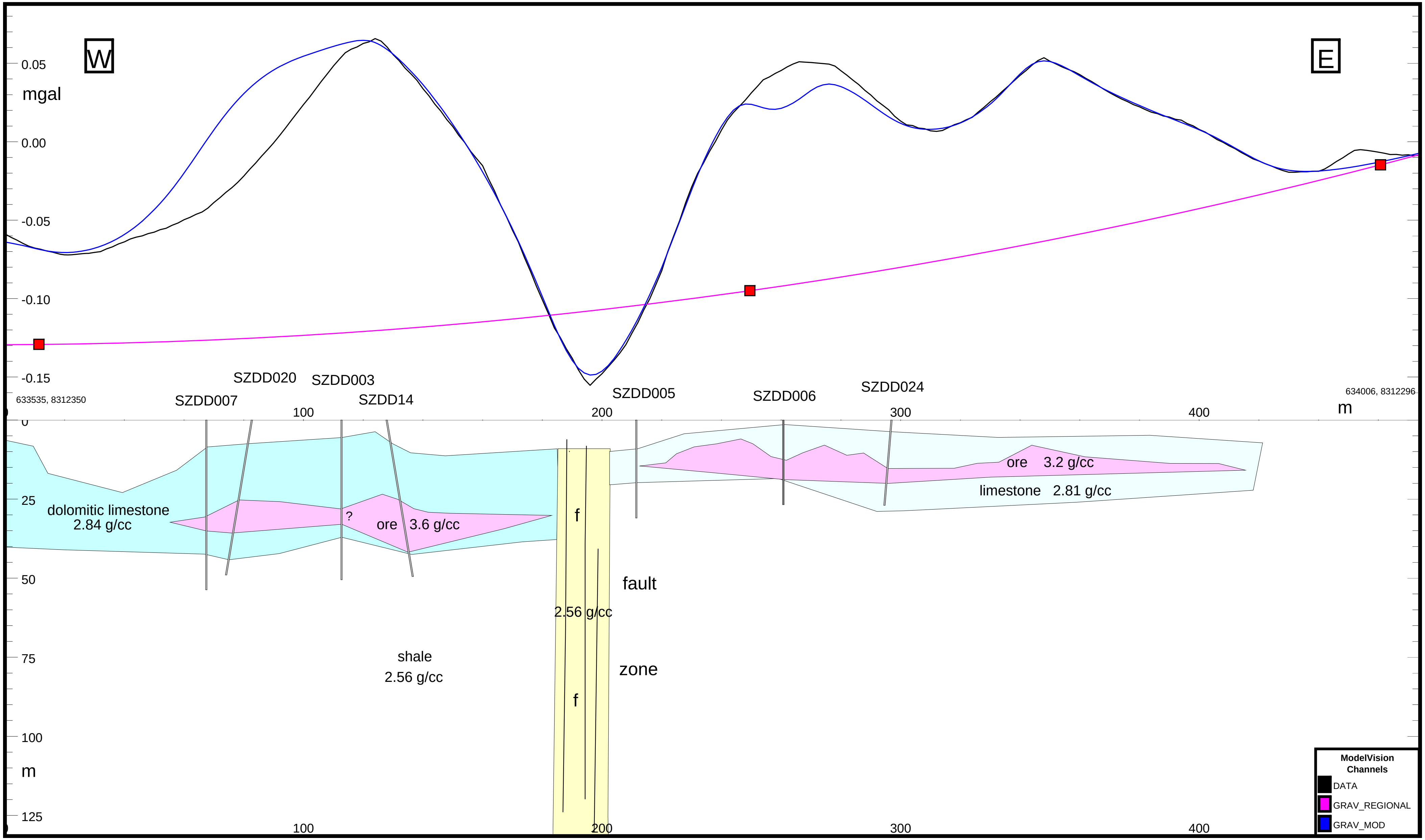
Resource Exploration and Development Gravity

Star Zinc Deposit: Line 5 Gravity Model 1: Drill Control



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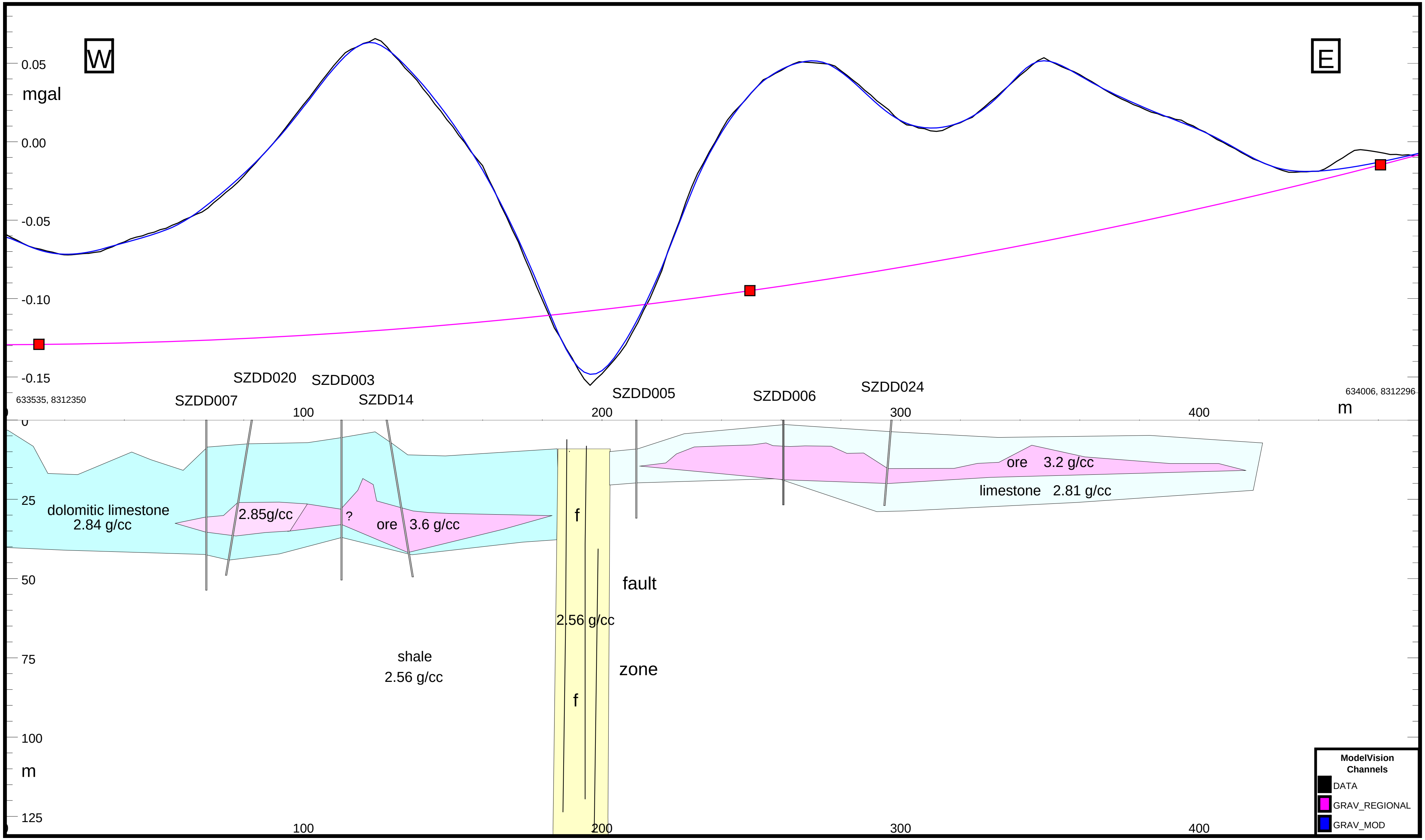
Resource Exploration and Development Gravity

Star Zinc Deposit: Line 5 Gravity Model 2: Gravity Fit



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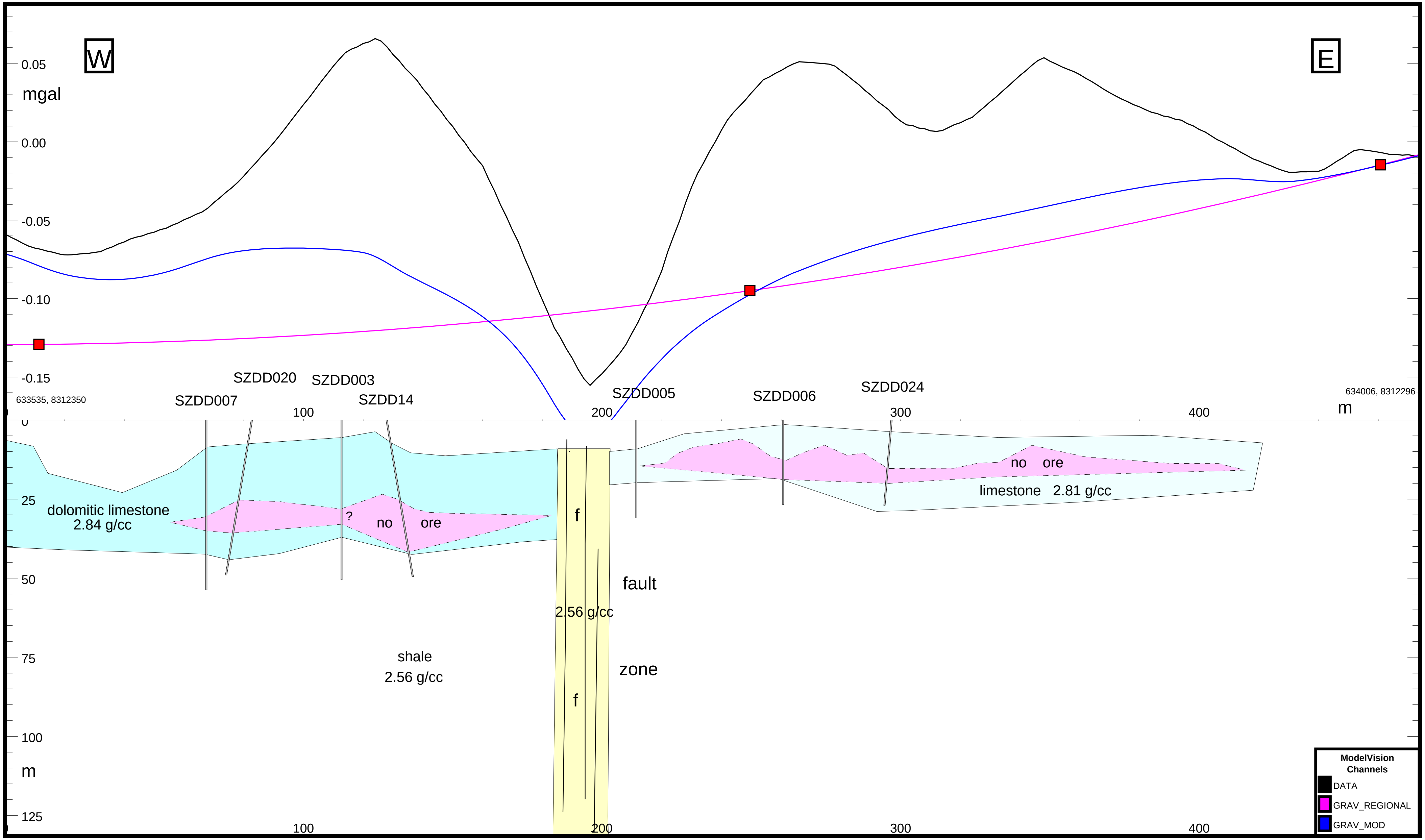
Resource Exploration and Development Gravity

Star Zinc Deposit: Line 5 Gravity Model 4: Barren



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Resource Exploration and Development Gravity

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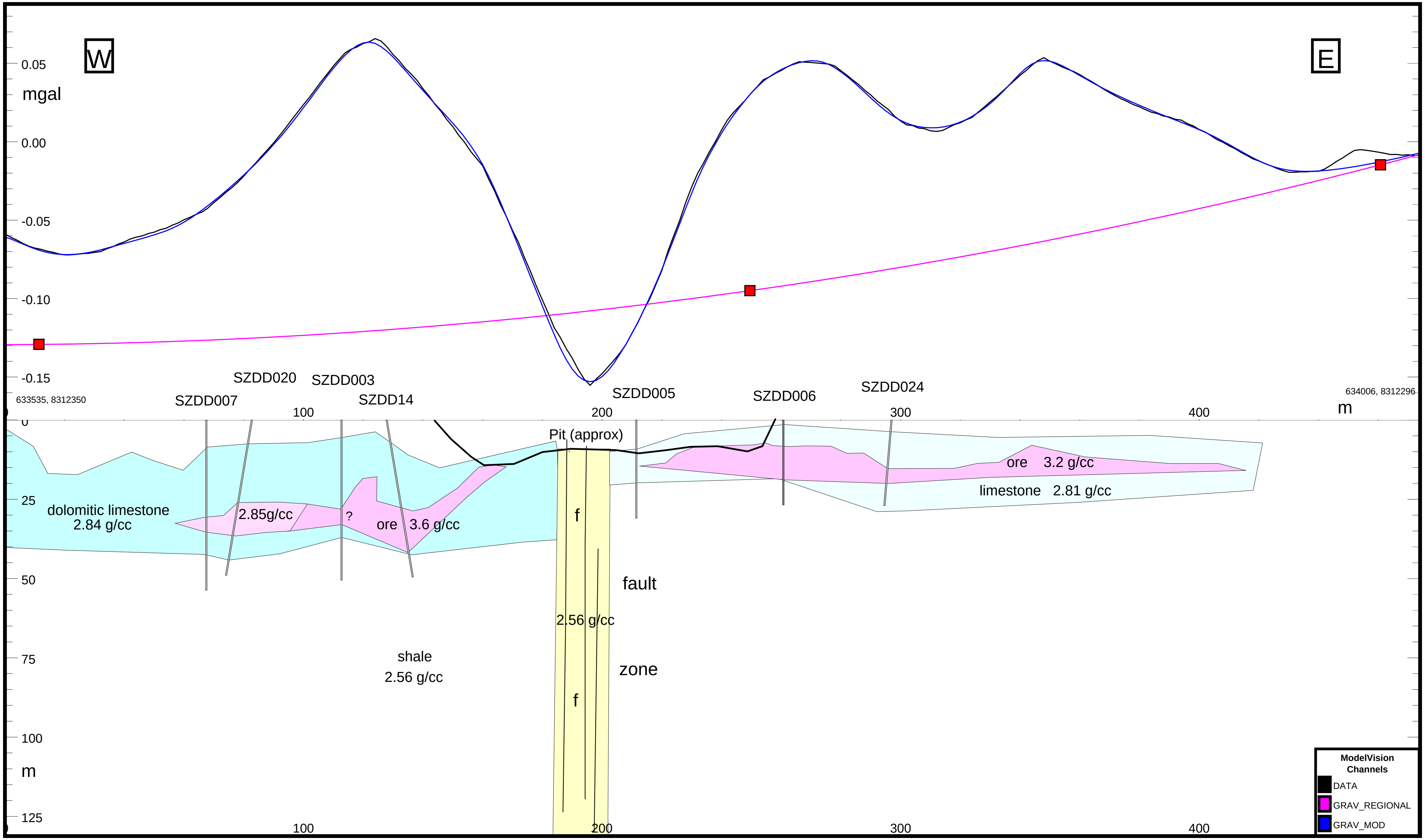

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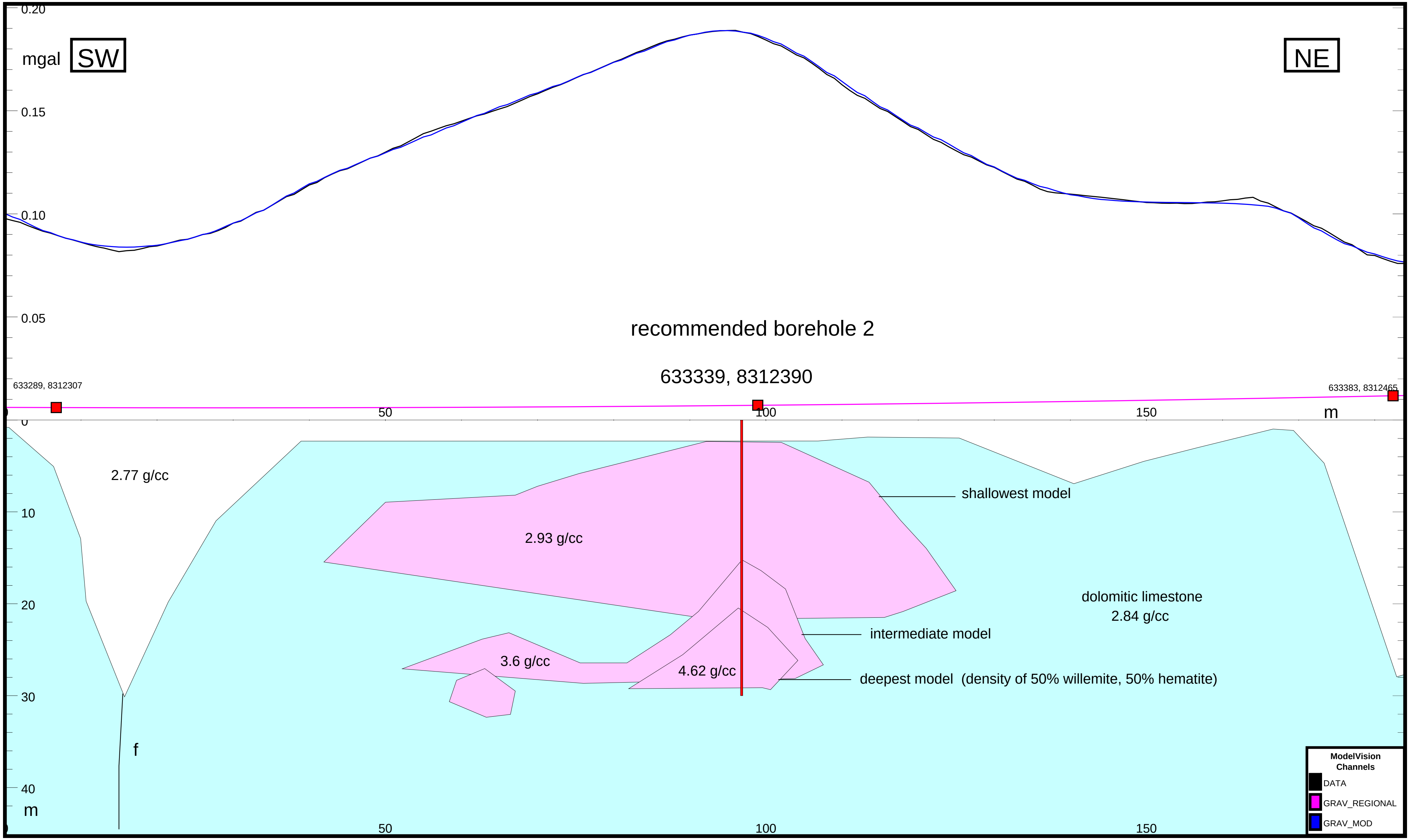
Galileo Resources Plc

Resource Exploration and Development Gravity

Star Zinc Deposit: Line 6 Gravity Models: All Depths



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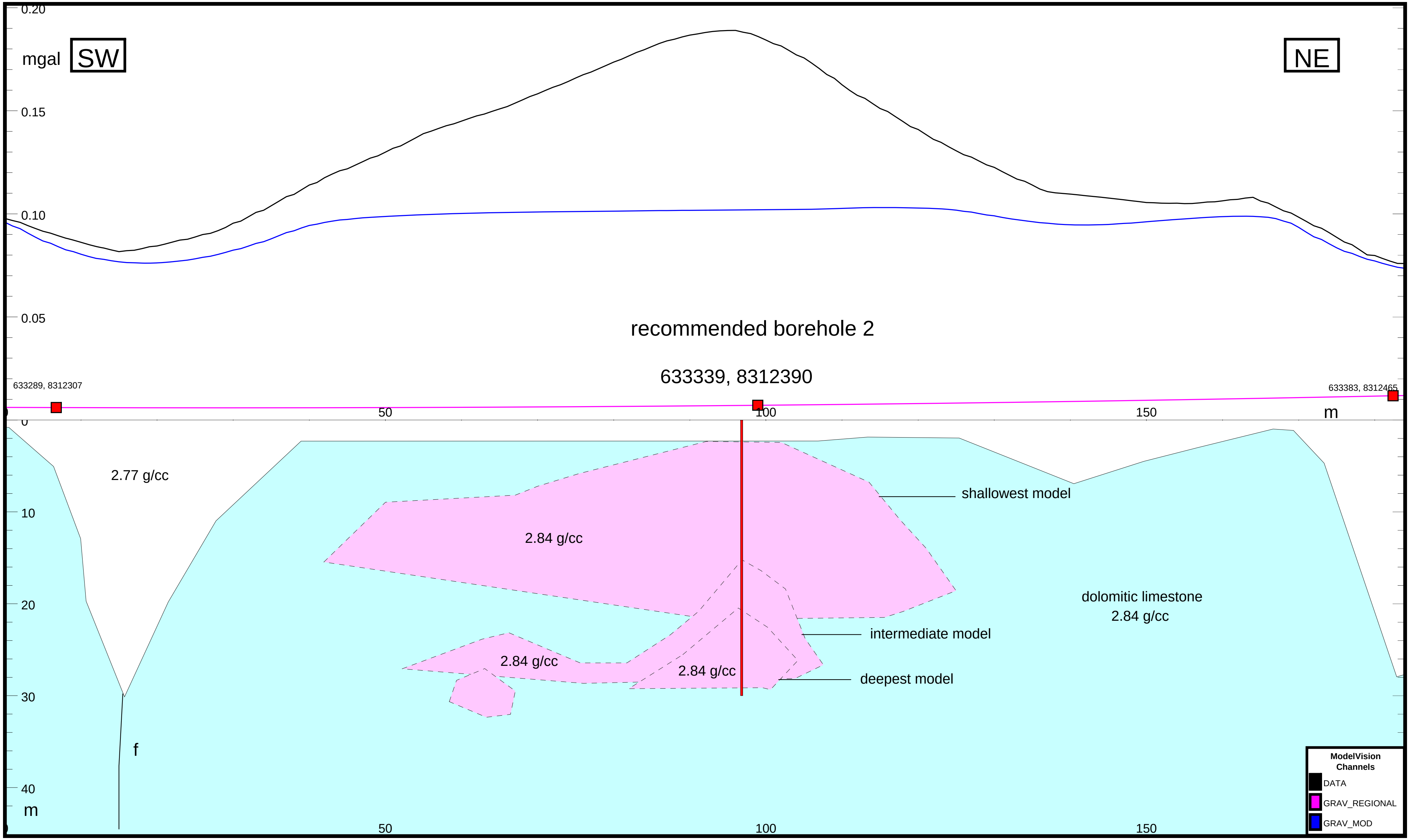

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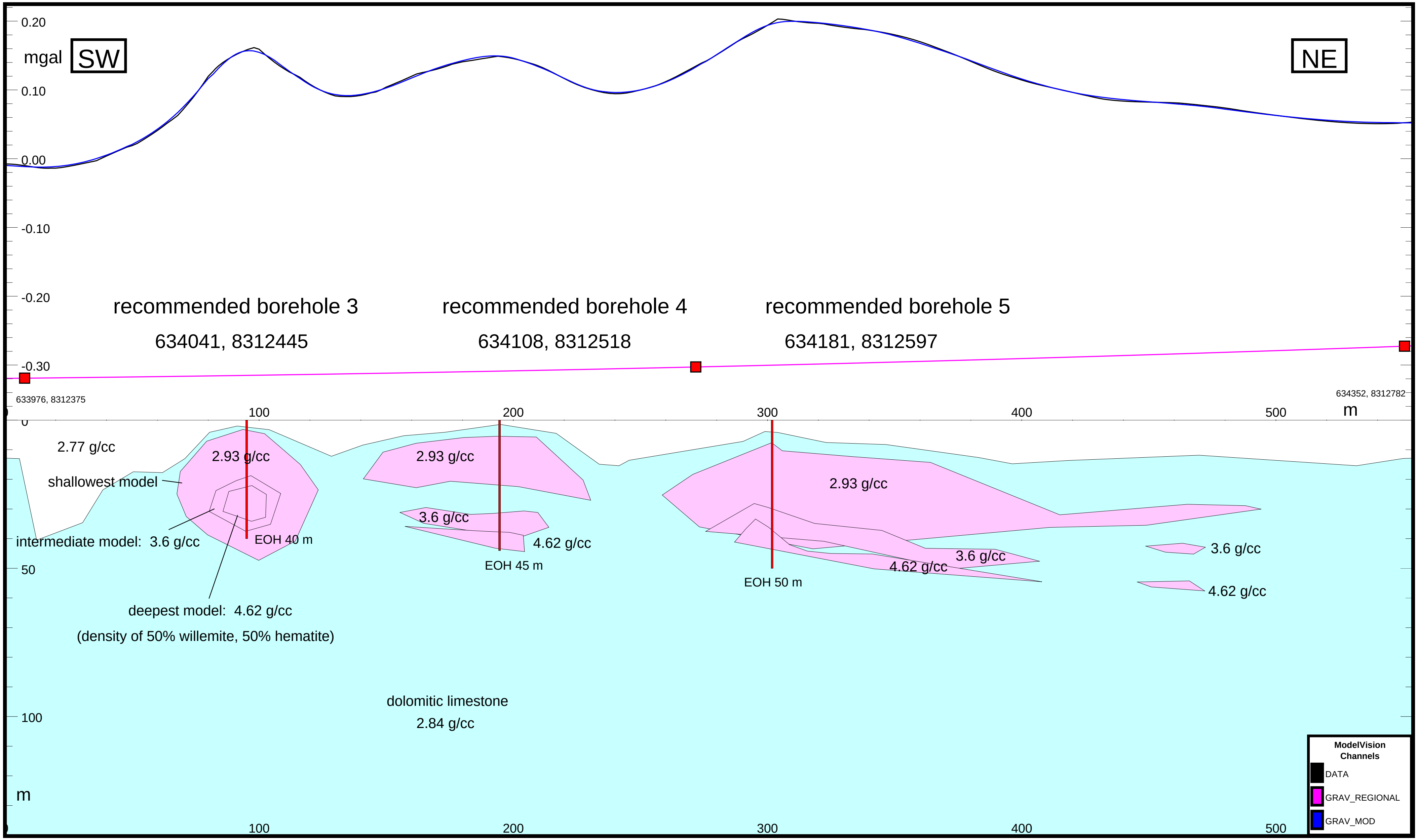
Resource Exploration and Development Gravity

Star Zinc Deposit: Line 7 Gravity Models: All Depths



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Resource Exploration and Development Gravity

Star Zinc Deposit: Line 7 Gravity Model: Barren