Applied Technology and Best Practices in CEE

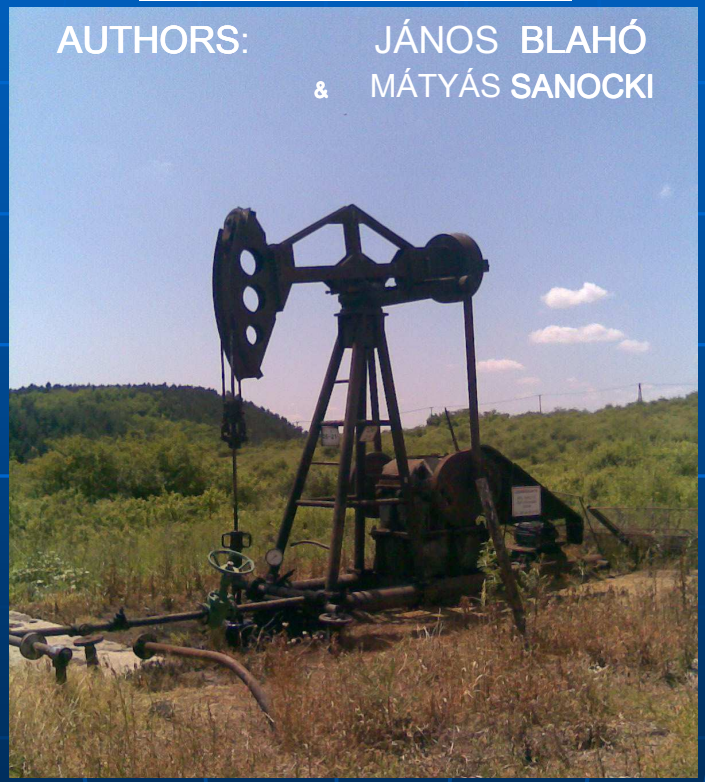
Conference

Budapest, 17 November 2011

Society of Petroleum Engineers

Object based turbidite modelling of Demjén Fields

AUTHORS: JÁNOS BLAHÓ
& MÁTYÁS SANOCKI



INTERPRETER: JÁNOS BLAHÓ

Society of Petroleum Engineers

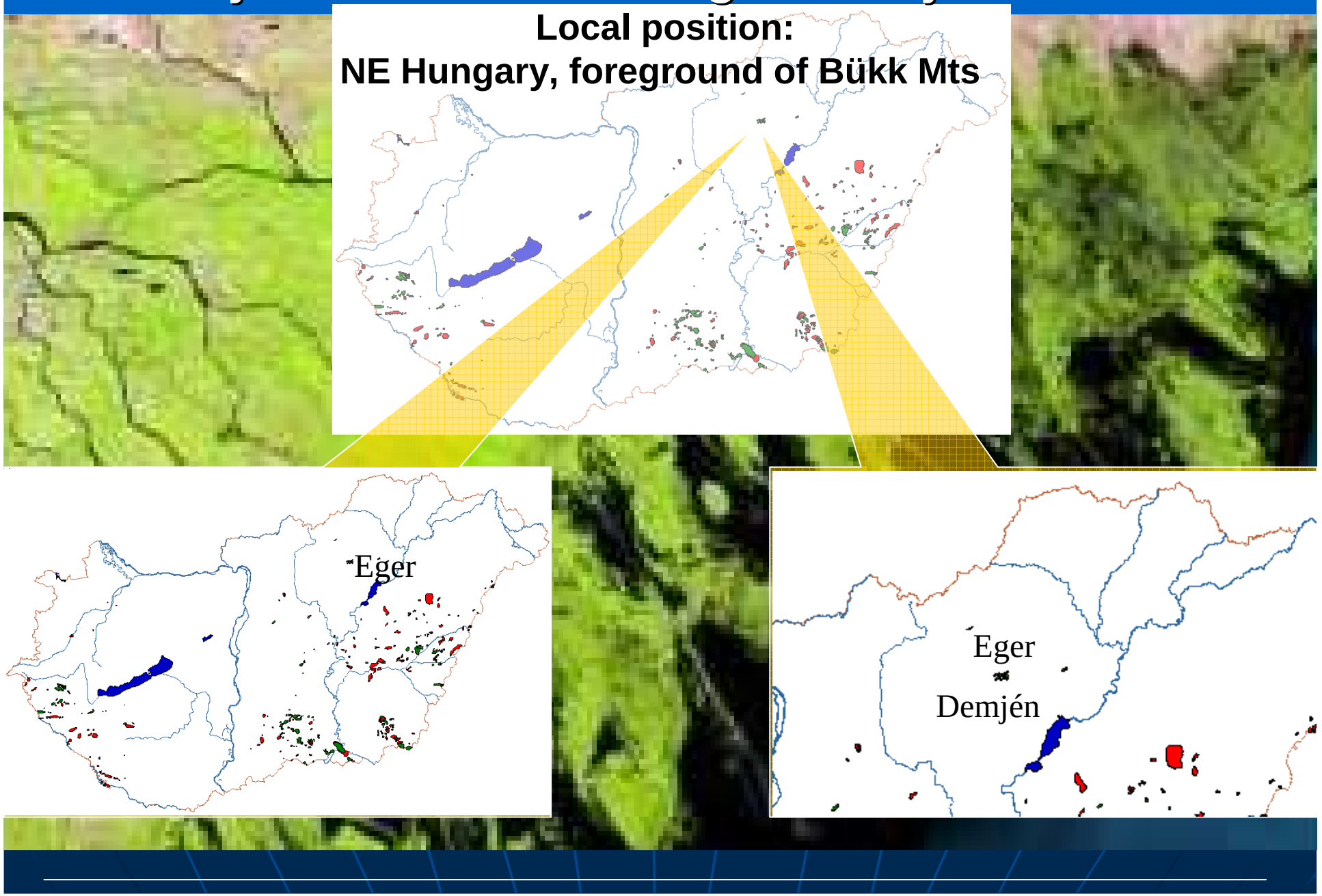
Object based modelling of Demjén Fields

Studies and Issues of Demjén area

DATE	FIELD-RESERVOIR	TITLE	AUTHORS
1966		Mérési adatok feldolgozása és értelmezése a szénhidrogénkutatás és termelés mélyfúrási geofizikai vizsgálatainál I-II.	Barlai Zoltán
1968		Az agyag- és aleurit- frakció szerepe az algyői felső- pannoniai tároló kőzetek kőzetfizikai tulajdonságainak kialakításában Magyar Geofizika IX. évf. 6.sz. 201÷223. old. 1968.	Szilágyi Endre
1970		Geofizikai kutatási módszerek II. Mélyfúrási geofizika	Markó-Sebestyén-Stegena
1976-77	Demjén Kelet	Demjén- Kelet-i kőolajmező összefoglaló földtani kutatási zárójelentése és vagyonszámítása	N.K.F.V.
		FINAL REPORT OF DEMJÉN KELET ALGYO FIELD EXPLORATION STUDY	N.K.F.V
1979	Demjén Nyugat	Demjén-Nyugat mező művelésének elemzése, és előrejelzése	N.K.F.Ü.
		RESERVOIR STUDY OF DEMJÉN NYUGAT FIELD	
1985	De K és DeP	Demjén-Kelet és Demjén-Pünkösdhegy területek tovább kutatásának vizsgálata	Bérczi I.-né SZ.K.F.I.
		STUDY OFIELD EXPLORATION OF DEMJÉN KELET AND DEMJÉN PÜNKÖSDHEGY AREAS	
1989		Mélyfúrási geofizikai értelmezési modellek és összehasonlító elemzésük (Kutatási jelentés)	Ferenczi László NME
1989	Demjén Pünkösdhegy	Demjén-Pünkösdhegy mező művelési terve	N:K:F:V.
		RESERVOIR STUDY	
1989		Mélyfúrási Geofizika	Dr.Csókás János
2009	De, De K, DeP	DEMJÉN-KELET, DEMJÉN-NYUGAT ÉS DEMJÉN-PÜNKÖSDHEGY MEZŐK 3D rezervoárgeológiai modellje	BLAHÓ J.

There are 30 years between the earlier reservoir study the recent 3D geological modelling

Object based modelling of Demjén Fields



Object based modelling of Demjén Fields

Local position of wells

- De-1-70 (Demjén (West)
- DeK-1-471

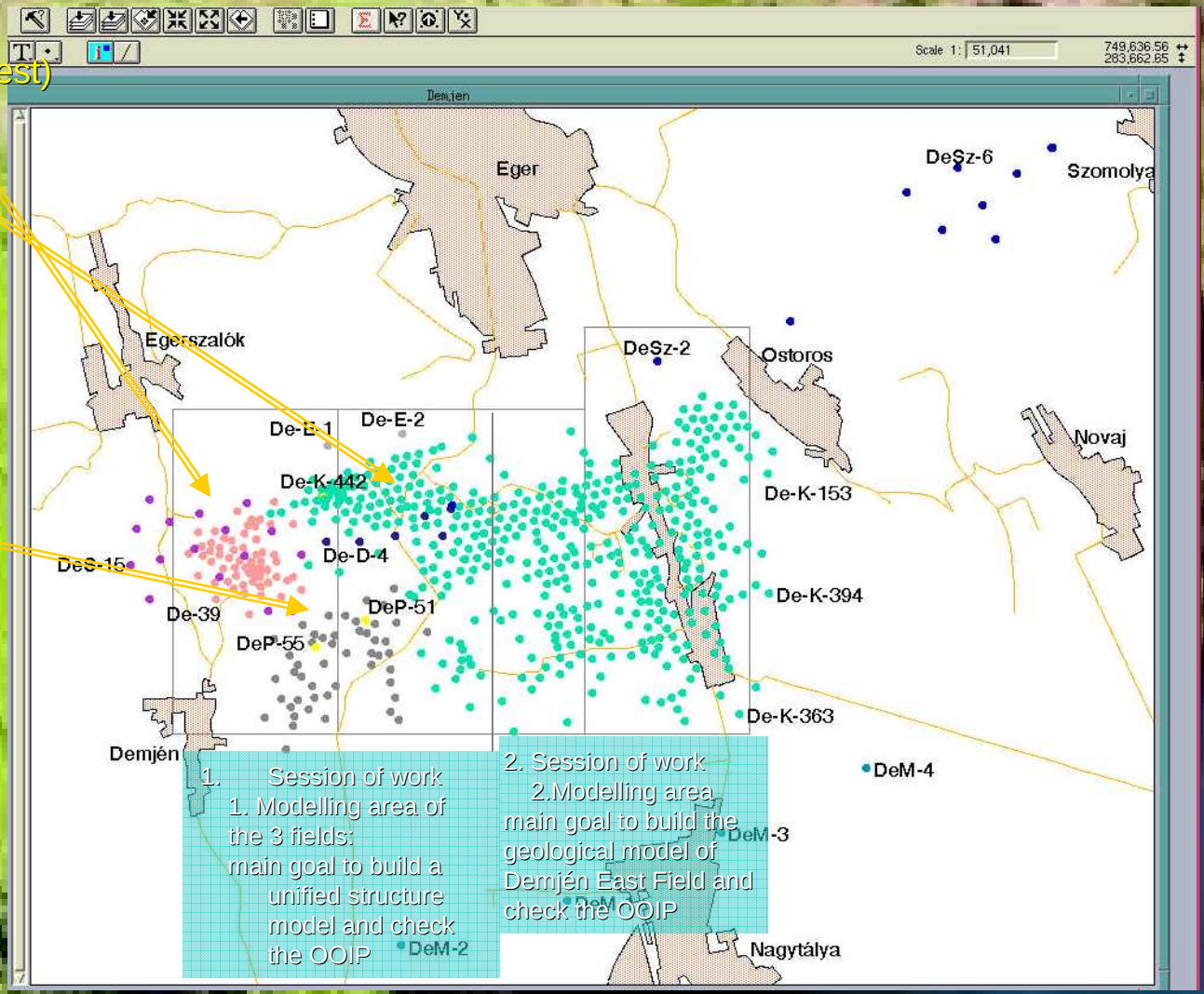
(Demjén-Kelet
or Demjen East)

- DK-I
- DeP-1-62

(Demjén-Pünkösdhegy)

Ds-1-16
(sekély, Mn)

- DD-1-6
  DÉ-1-2
  DSz-1-9
  (Demjén-Szomolya)
  Dm-1-4 (mély)



Object based modelling of Demjén Fields

Turbidite and shoreface Oil Reservoir complex:

Geological setting is Turbidite fan system consisting of 12 well defined turbidite cycles(„g" to „r") and their inner cycles. The cycles are built over each_other but some places on DeP and De-K areas there are missing cycles and there are missing sandstone bodies because of faults and erosion and somewhere we know that there was no sediment deposition at all. Above this series there are shoreface sediment intervals („a" to „f").

The structure is highly faulted with normal faults and strike slip faults.

Drilled 581 wells, Productive 333 wells (Ny 48, K 258, DeP 27) Area ~32 km^2 Put on production in 1957 OOIP ~$10*10^6$ m^3 from about 161 blocks (might be more). There were hydraulic fracturing many times and tests of EOR methods

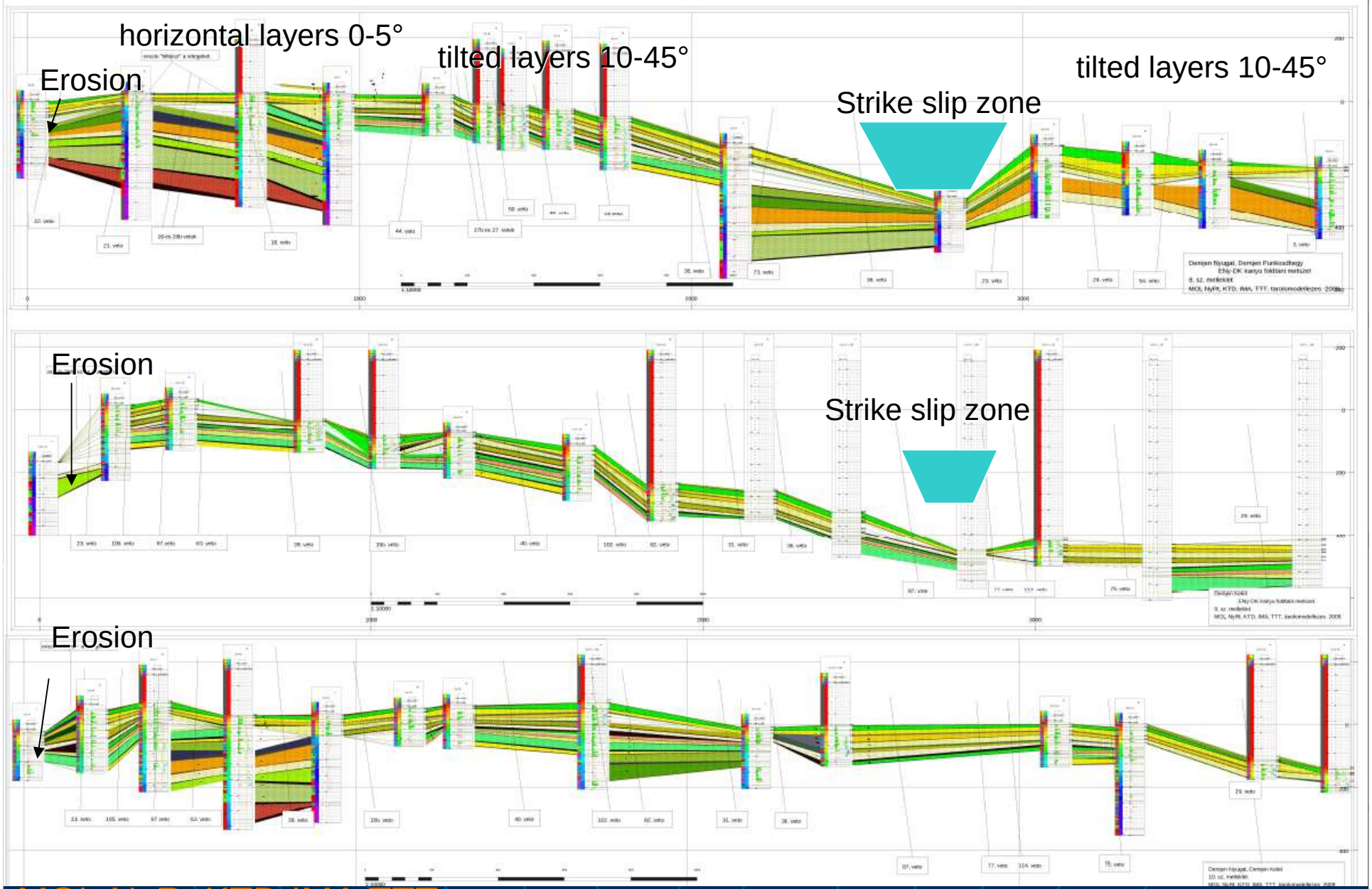
The reservoir depth is defind by:

TVDSS + 76,6 m (De-K-246) and between +80 - +90 m on top map

WOC alternating between +13.4 m over subsea and 597.4 m subsea level (North of strike slip zone) and 496-1574 m subsea level(south of strike slip zone)

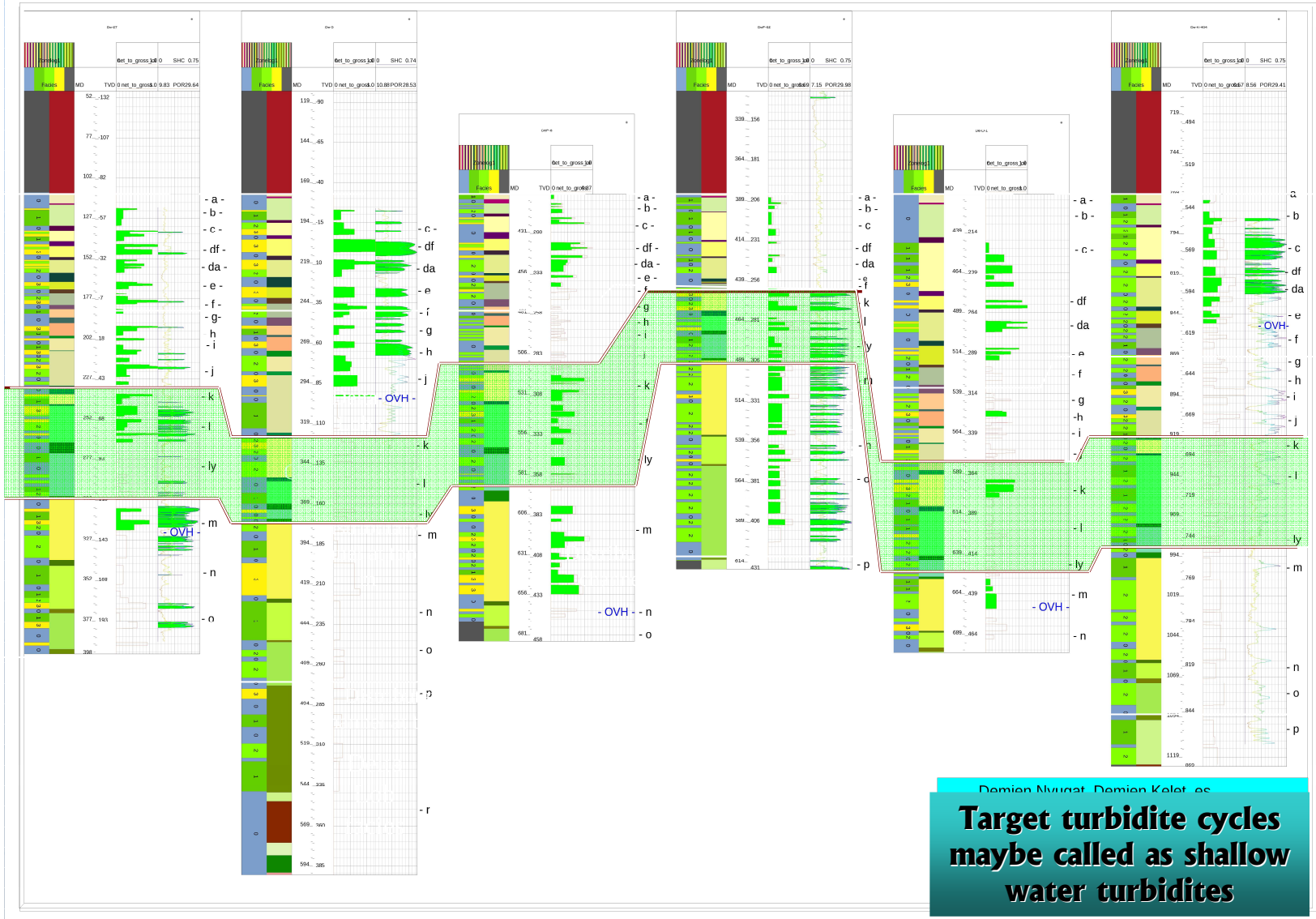
Etage : different in almost every well (separated prod.blocks, turbidite sand bodies).

Object based modelling of Demjén Fields



Object based modelling of Demjén Fields

Stratigraphic model on sample wells



Oligocén
Rupéli 3/b top

Shoreface Sediments „a" to „f"

Distributary Channels at top of k

Turbidite fan

Turbidites are not equal with the classic deepwater turbidites maybe called as shallow water turbidites

Target turbidite cycles maybe called as shallow water turbidites

Demjén Fields Petrophysical characterization

Oligocene : Kiscelli Agyag

-Turbidite style sediments. (by shallow water gravitational sediment transportation)

-Light grey sandtones, with alternating firmness (if $CaCO_3$ cement 8-20%)

- unstratified or stratified, 10-45º-slide surfaces, clay or sand intraclasts. In some layers there are charcoal fragments. The grains are well sorted.

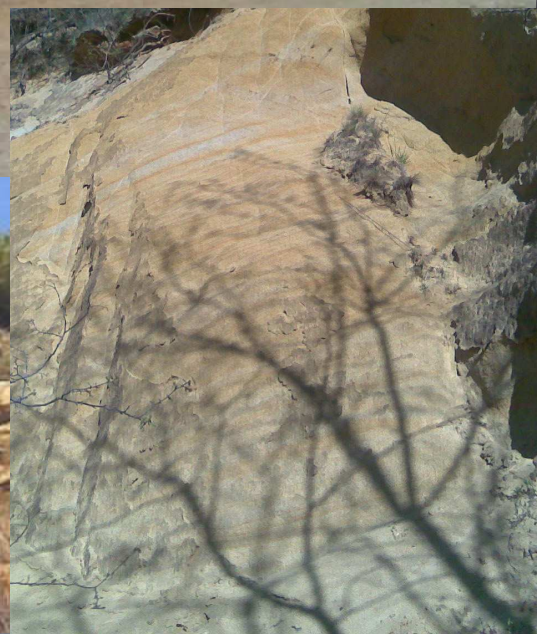
-Siltstone and shale interbeds, siltstone porosity sometimes relatively high (15-20 %, because of shallow covering) but because of pore texture the pore throats are small and permeability very low.

Demjén Fields Petrophysical characterization

Oligocene : Kiscelli Agyag

Demjén Fields Petrophysical characterization

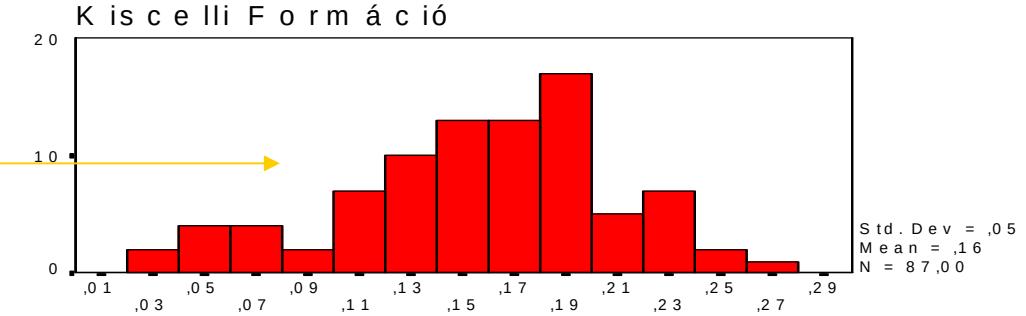
Oligocene: Kiscelli Agyag



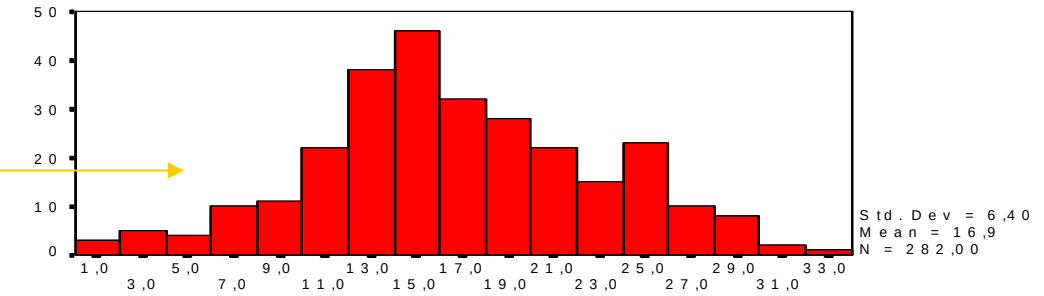
Demjéni fields reservoir rock characterization

Porosity histograms:

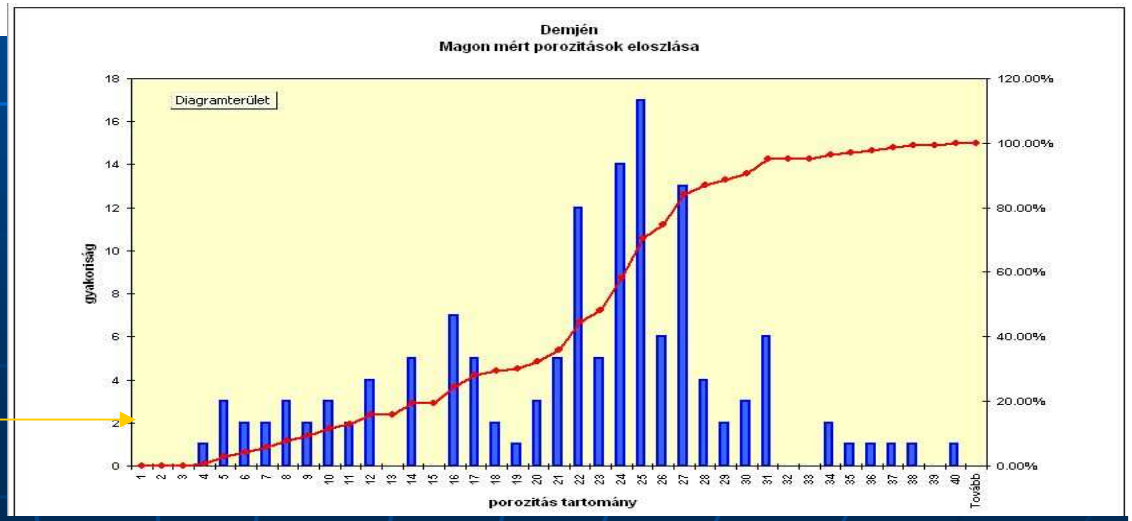
Shoreface and shallow marine fine sandstone



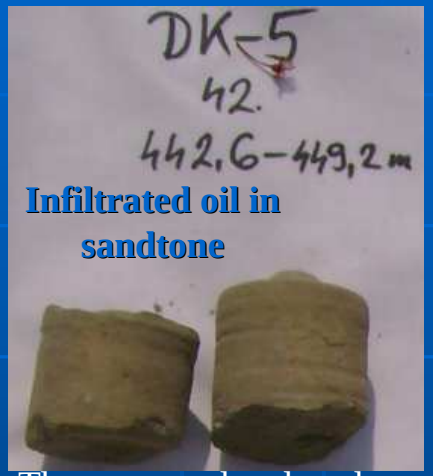
Tubidite type sediments

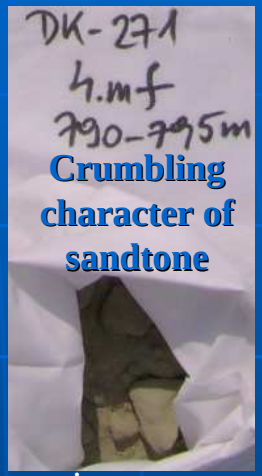


2 peak type distribution of measured porosity

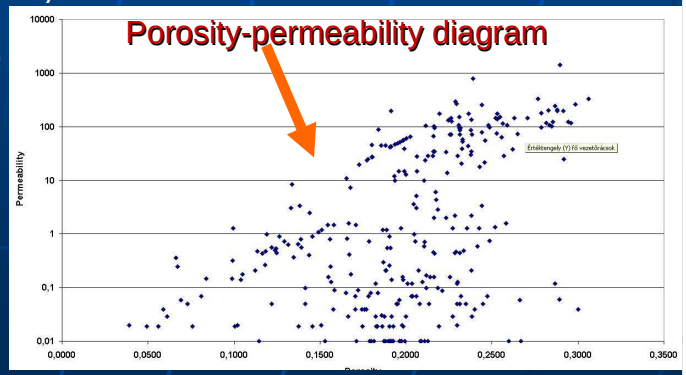


Demjén Nyugat, Demjén Kelet, és Demjén Pünködhegy Fields
Rock properties



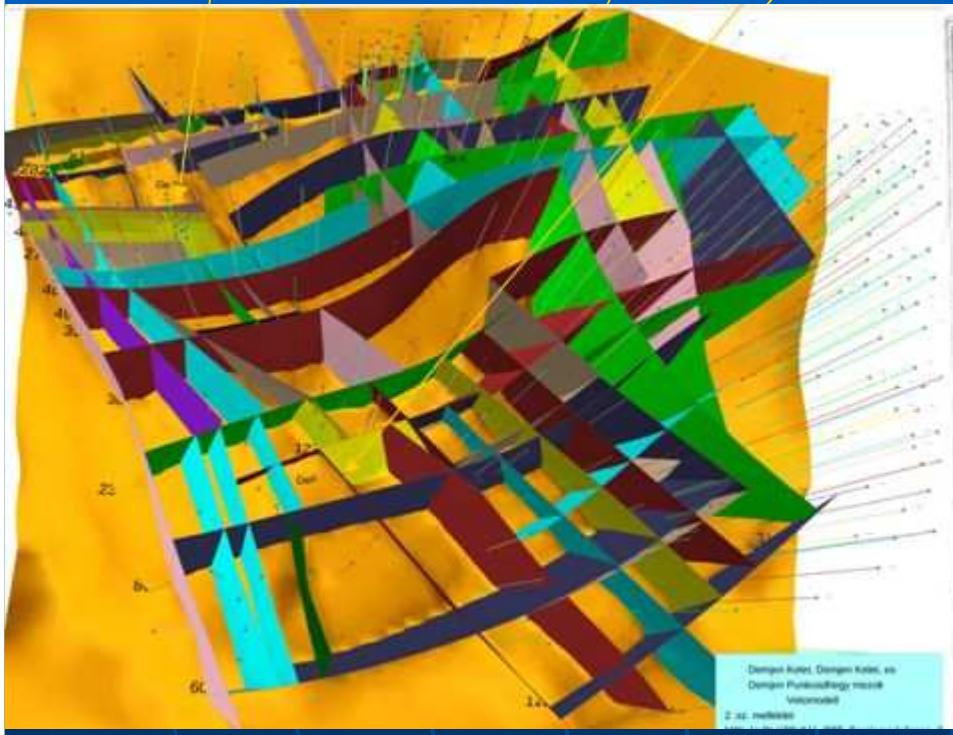


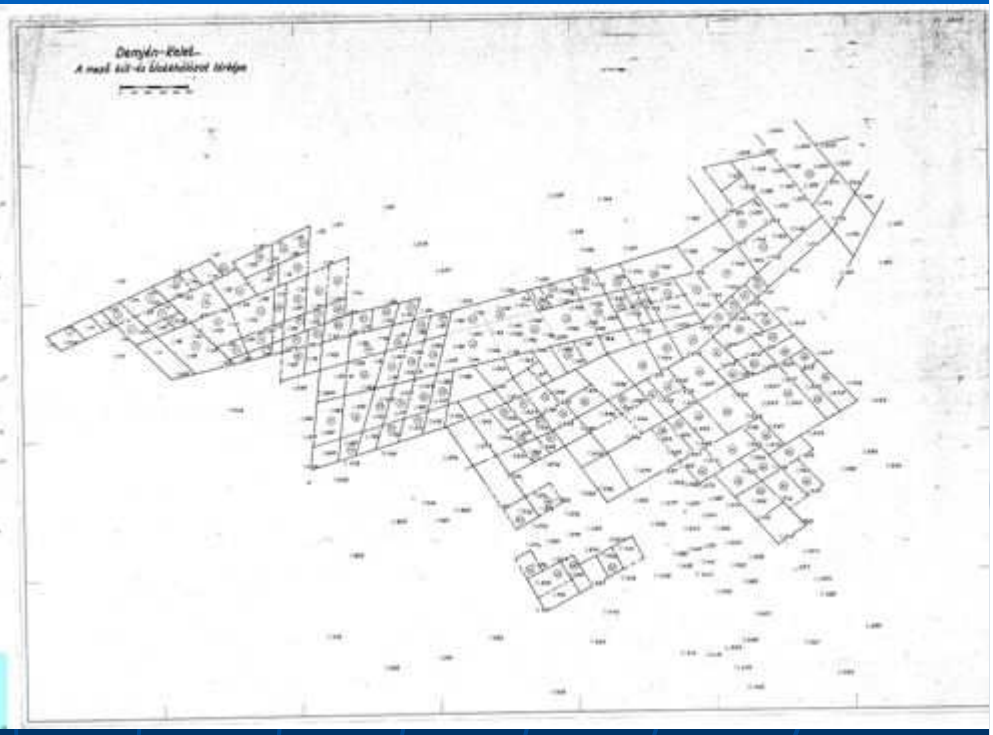
- The measured and evaluated data indicates the intense heterogenity of the reservoir
- Porosity in average ≈ 23,5% with 2 peak type distribution 9-**16**-18.5%, and 18.5-25.5-32% (some extra measured ss.: 32-40%)
- Permeability is not describable by an average value but the weighted average: **20,8** md
- Sw: most of all 40-60 %, average is 54 %, whole range in the model: 20-85 %



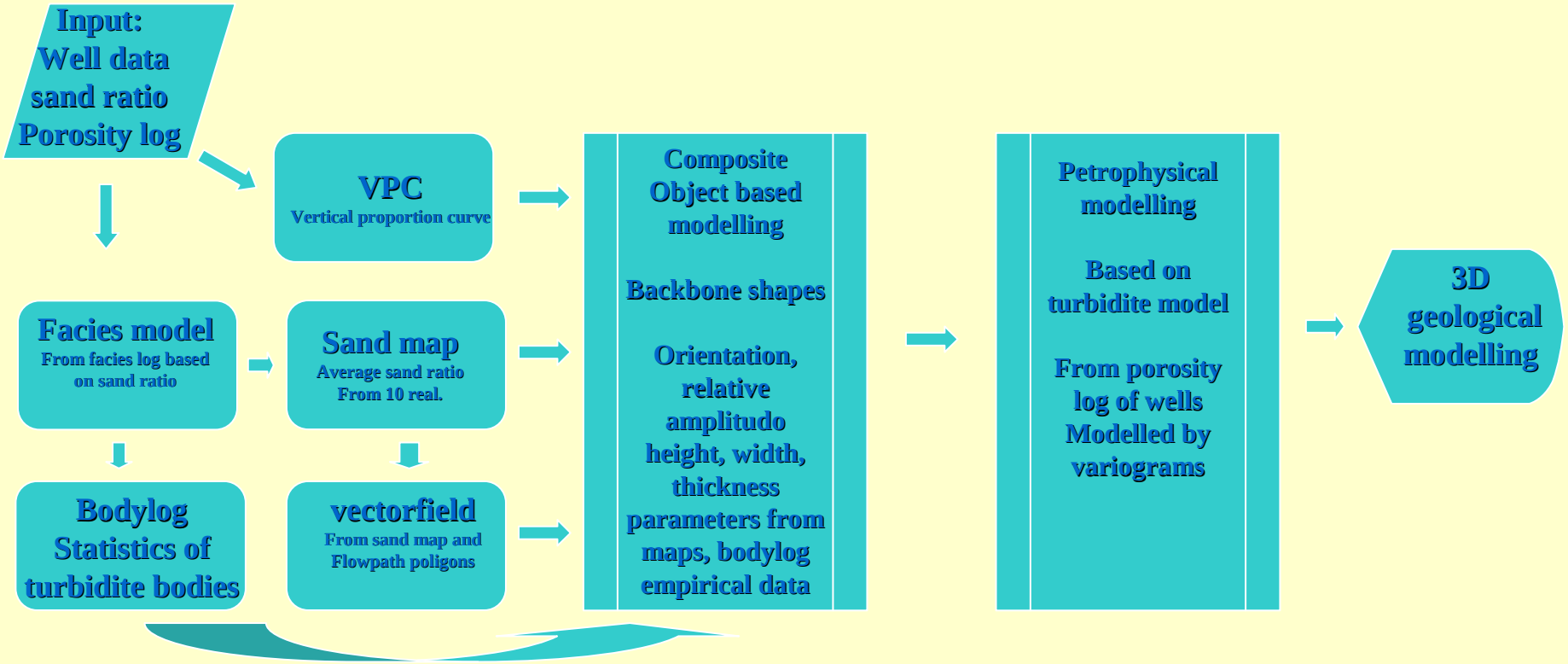
Demjén Nyugat, Demjén Kelet, és Demjén Pünködhegy Fields 3D

Complicated geological structural model - Demjén Kelet productive blocks



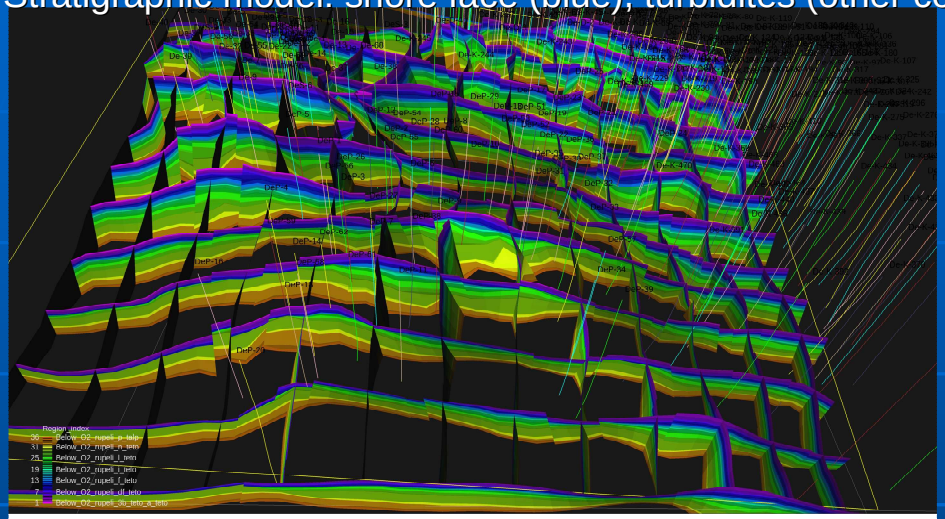


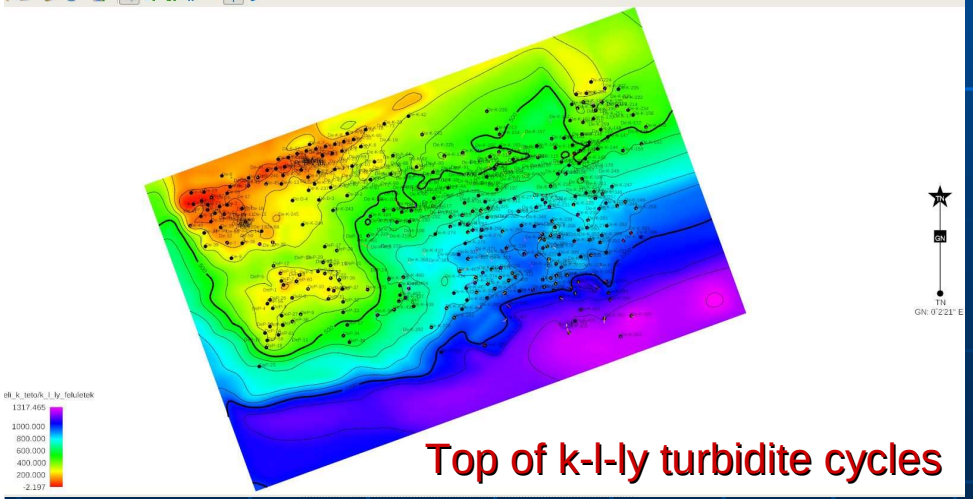
Demjén Fields Objectbased turbidite modelling workflow

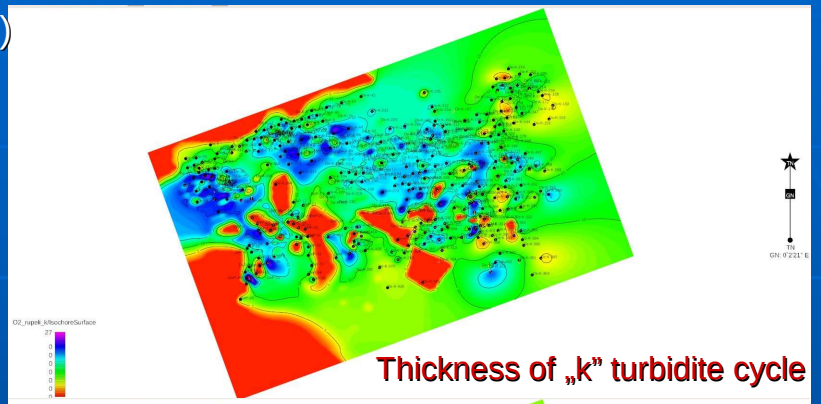


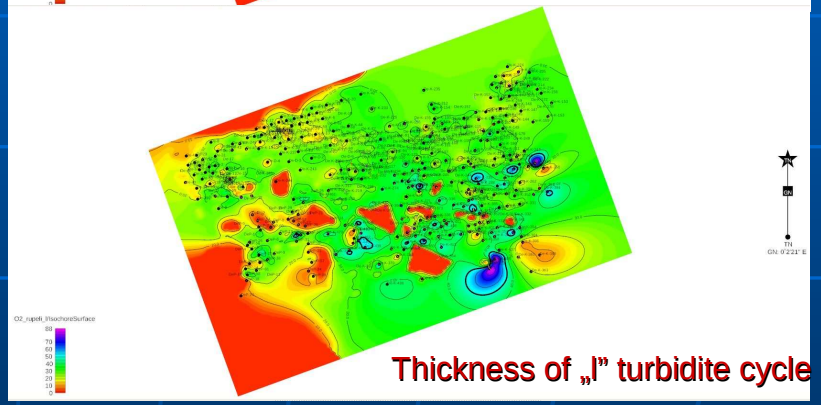
Demjén Fields 3D geological modelling

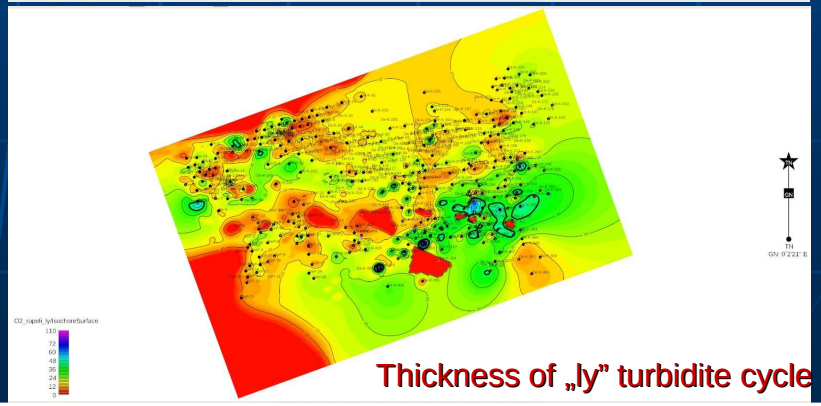
Stratigraphic model: shore face (blue), turbidites (other colours)





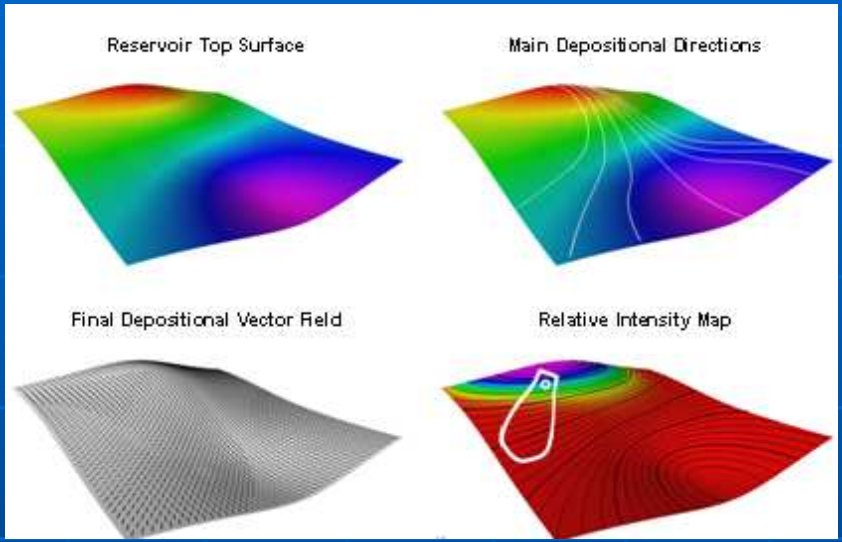


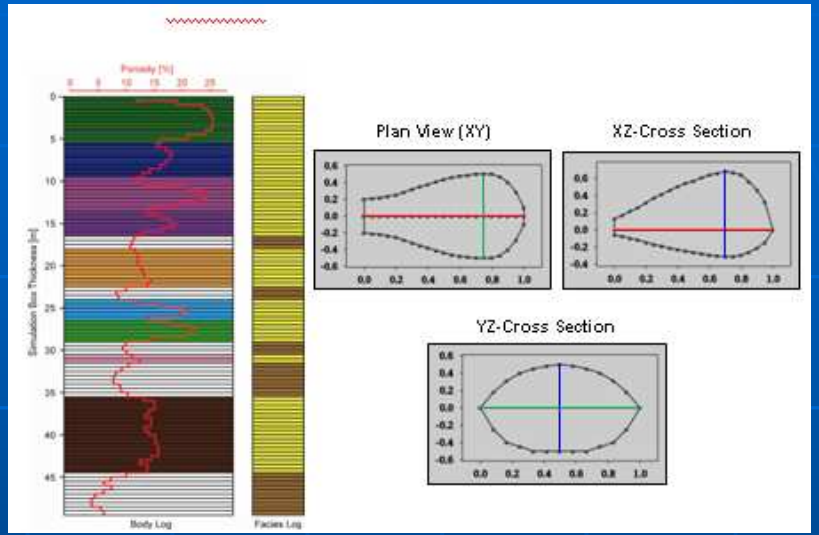


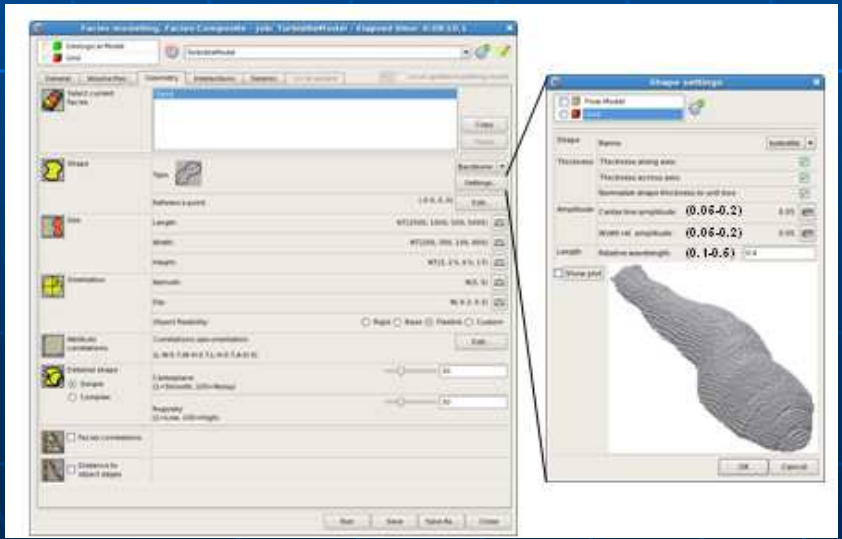


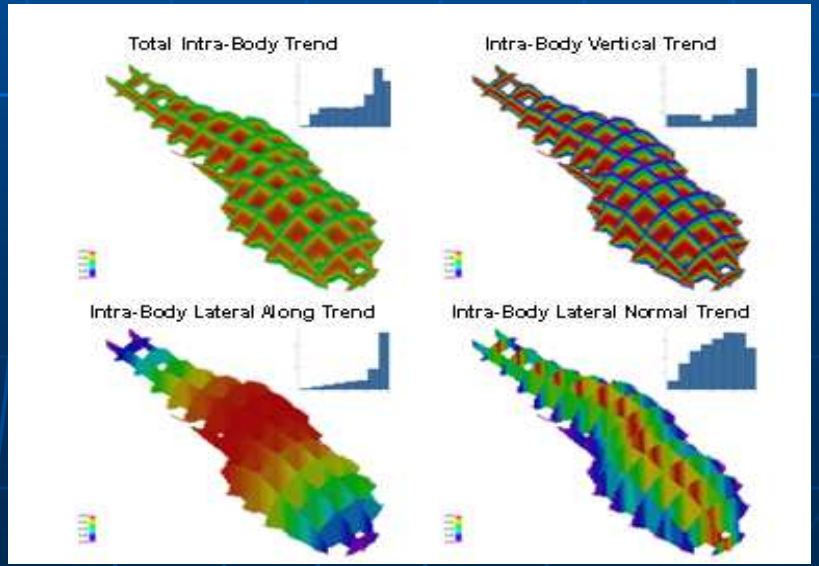
Object based modelling of Demjén Fields

Inputs, shape parameters, intrabodytrends



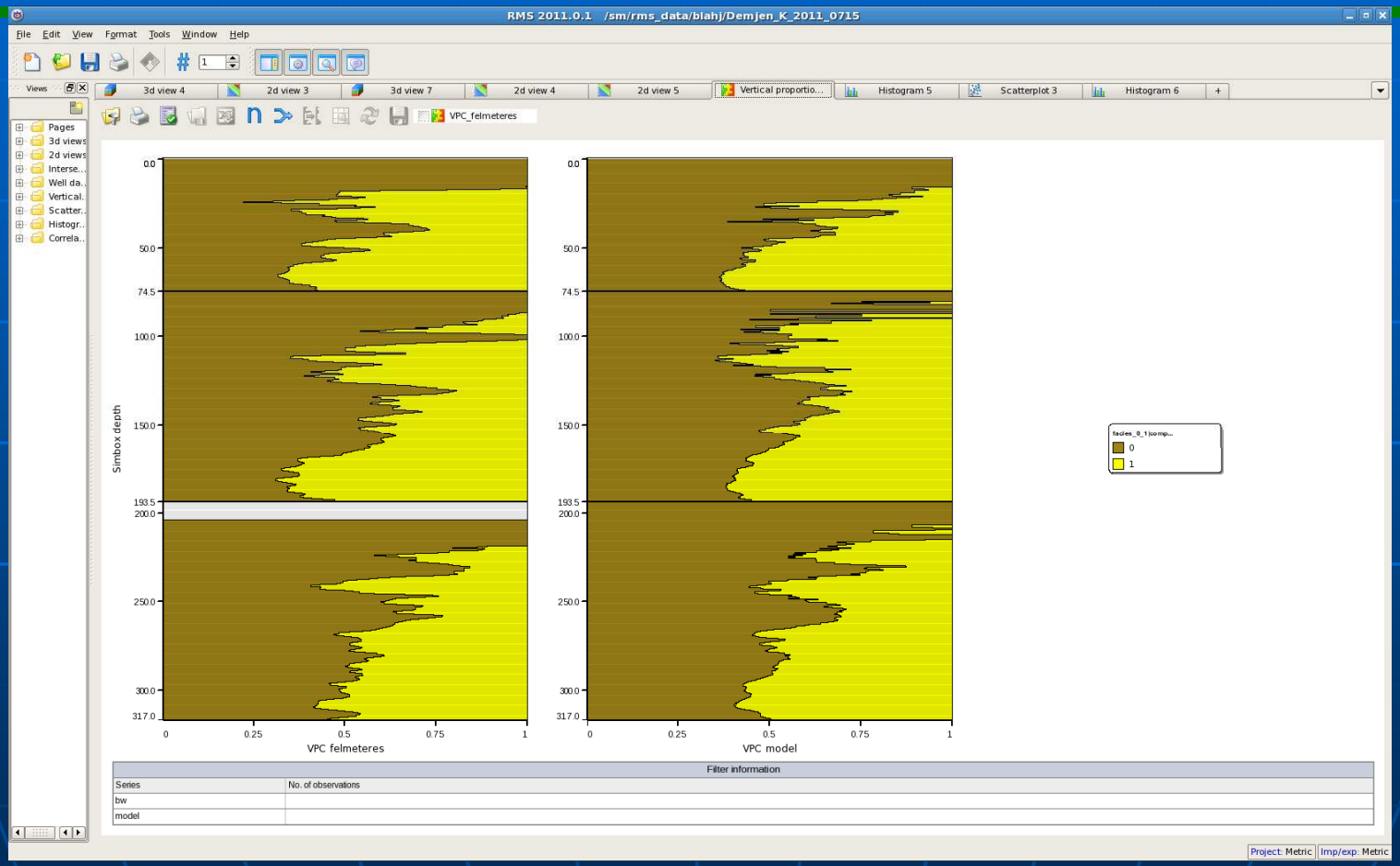






Demjén Fields Vertical proportion curve

Facies 1 calculated above 15% sand ratio and facies 0 background in simbox layers

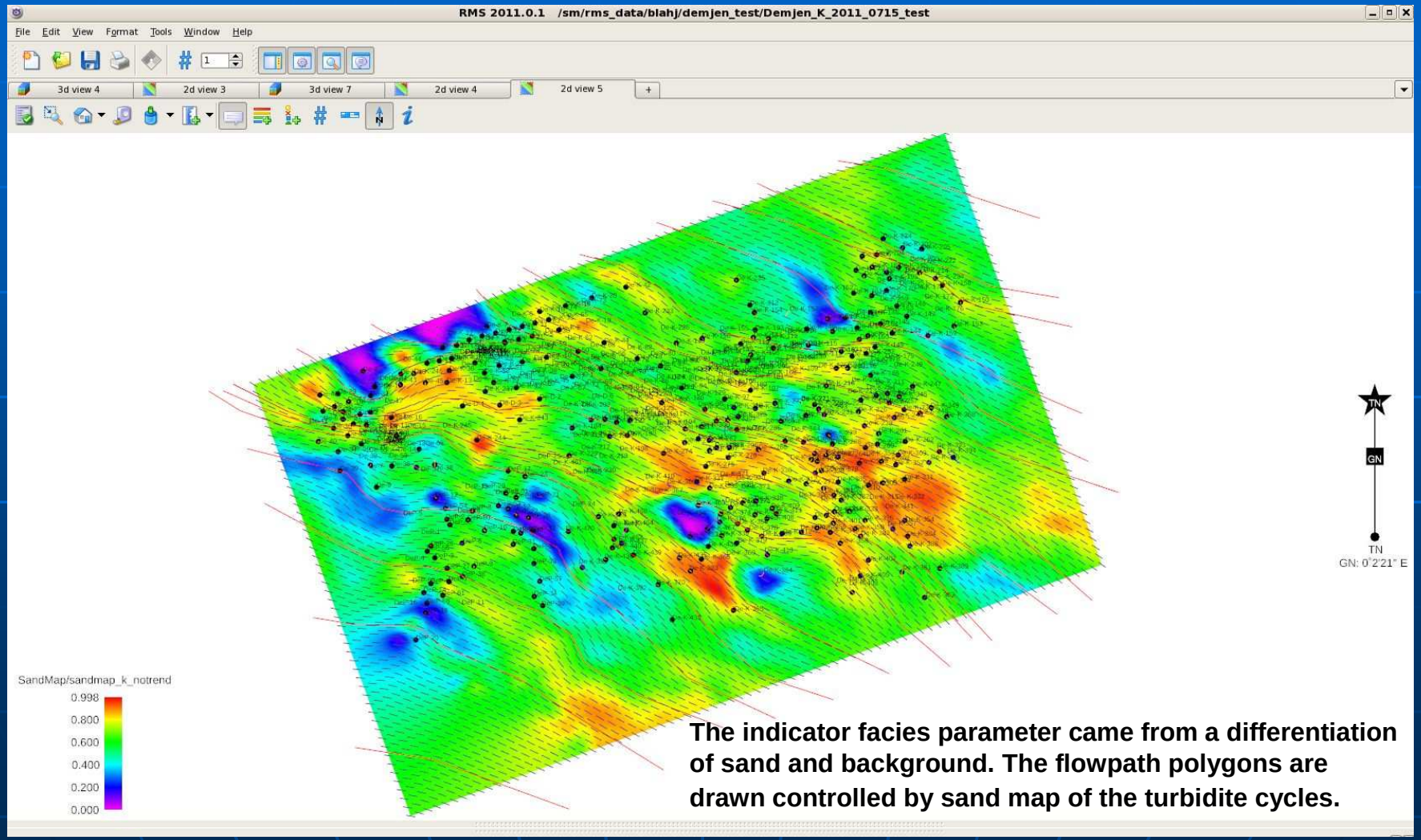


The facies based on sand ratio in different depth below the top of reservoir characterisethe development of the turbidite fan. The similarity between the two VPC indicate how the facies model approximated the original facies distribution.

Object based modelling of Demjén Fields

Indicator facies, Sandmap + flowpath polygons + stickplot of vectorfield

„k”
cycle

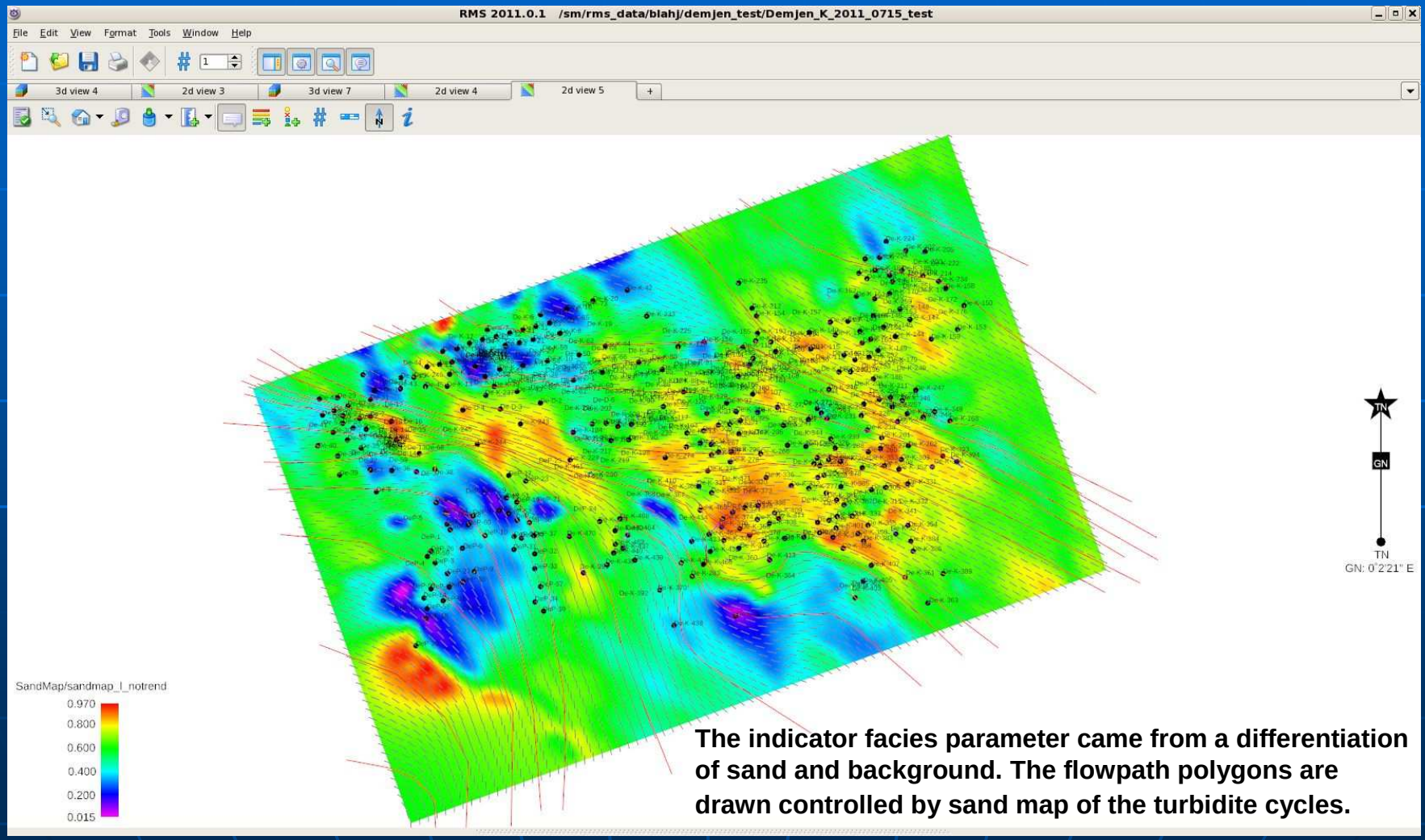


The indicator facies parameter came from a differentiation of sand and background. The flowpath polygons are drawn controlled by sand map of the turbidite cycles.

Object based modelling of Demjén Fields

Indicator facies, Sandmap + flowpath polygons + stickplot of vectorfield

„l”
cycle

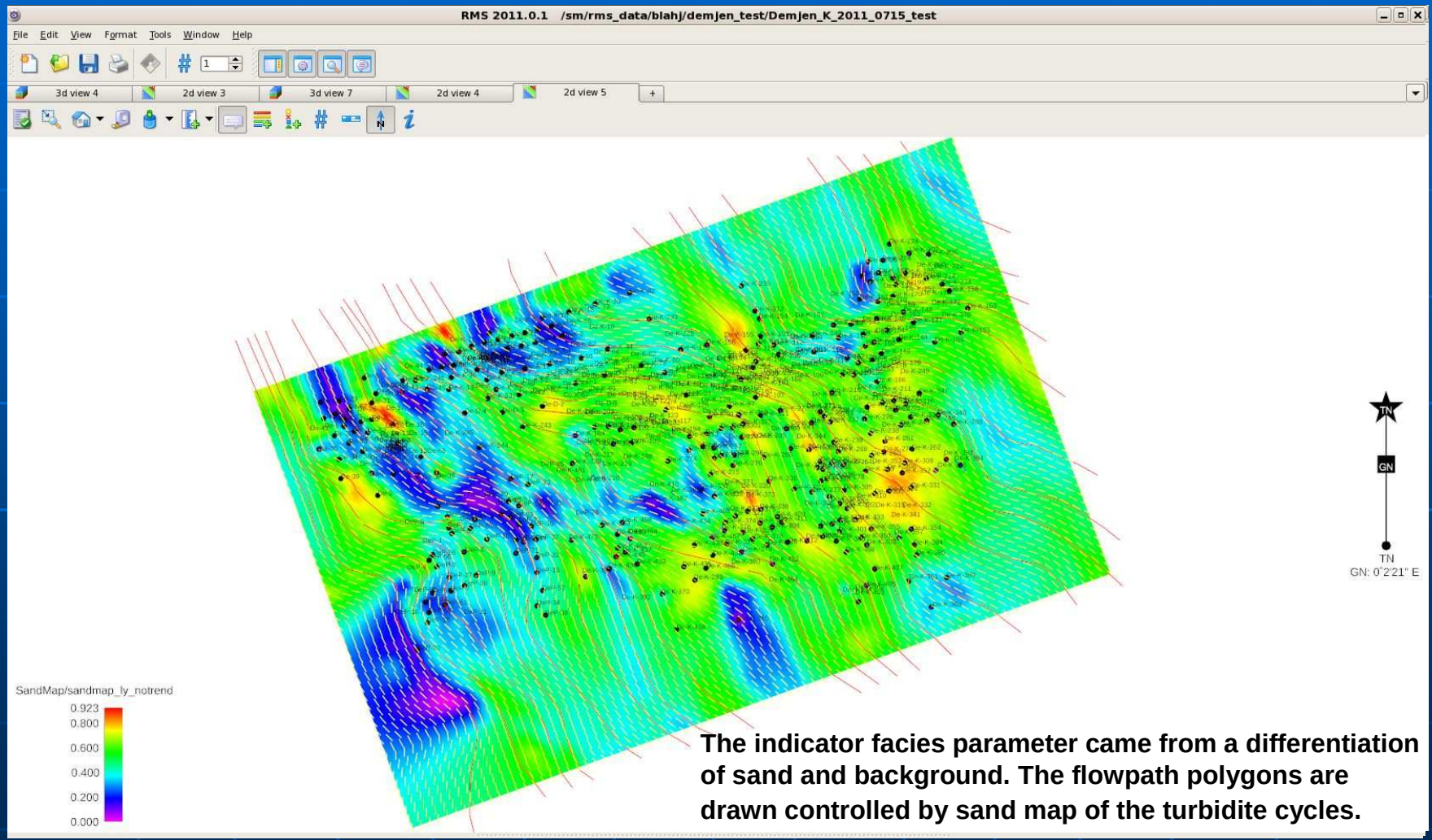


The indicator facies parameter came from a differentiation of sand and background. The flowpath polygons are drawn controlled by sand map of the turbidite cycles.

Object based modelling of Demjén Fields

Indicator facies, Sandmap + flowpath polygons + stickplot of vectorfield

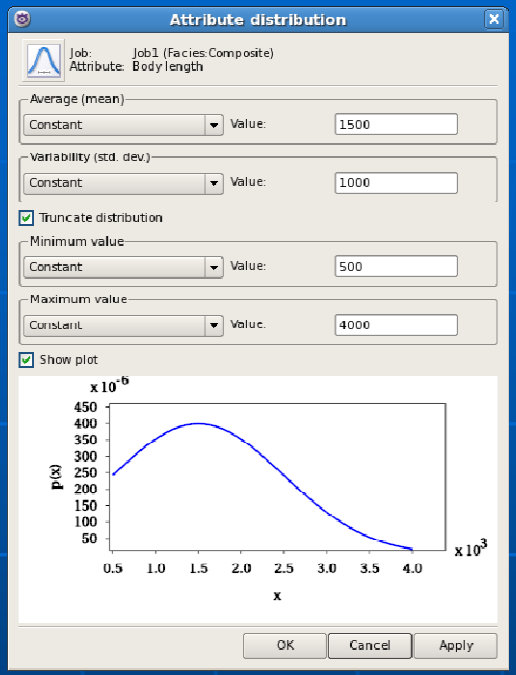
„ly”
cycle



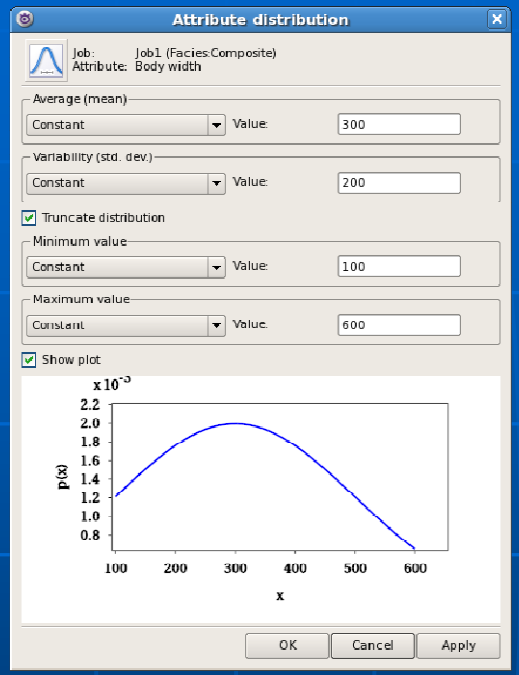
The indicator facies parameter came from a differentiation of sand and background. The flowpath polygons are drawn controlled by sand map of the turbidite cycles.

Object based modelling of Demjén Fields

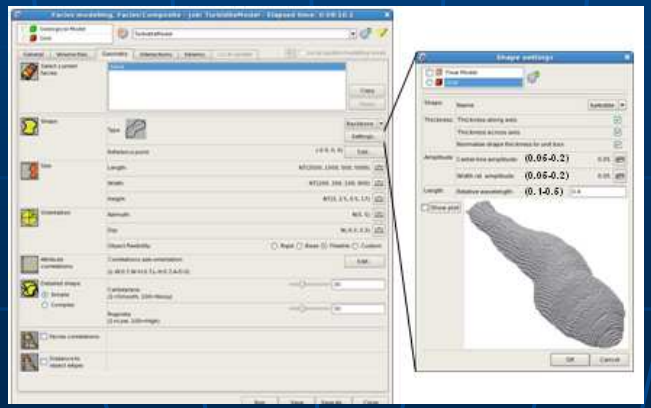
Geometric parameters

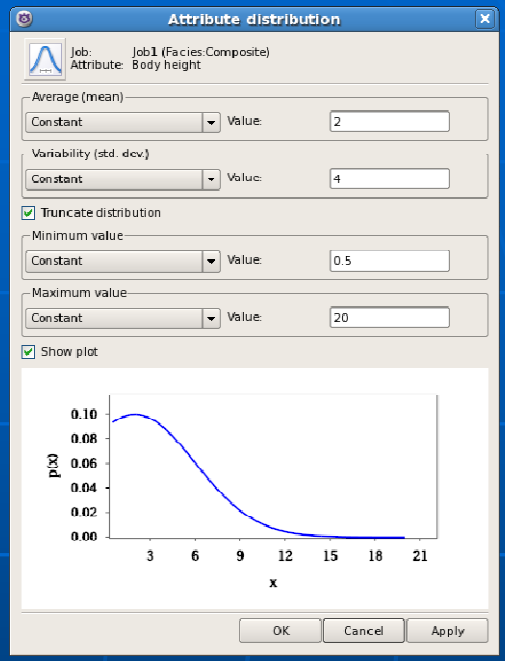


The statistics of the length of sand bodies in the turbidite cycles particularly around 1500 m with a wide range.



The statistics of the width of sand bodies in the turbidite cycles



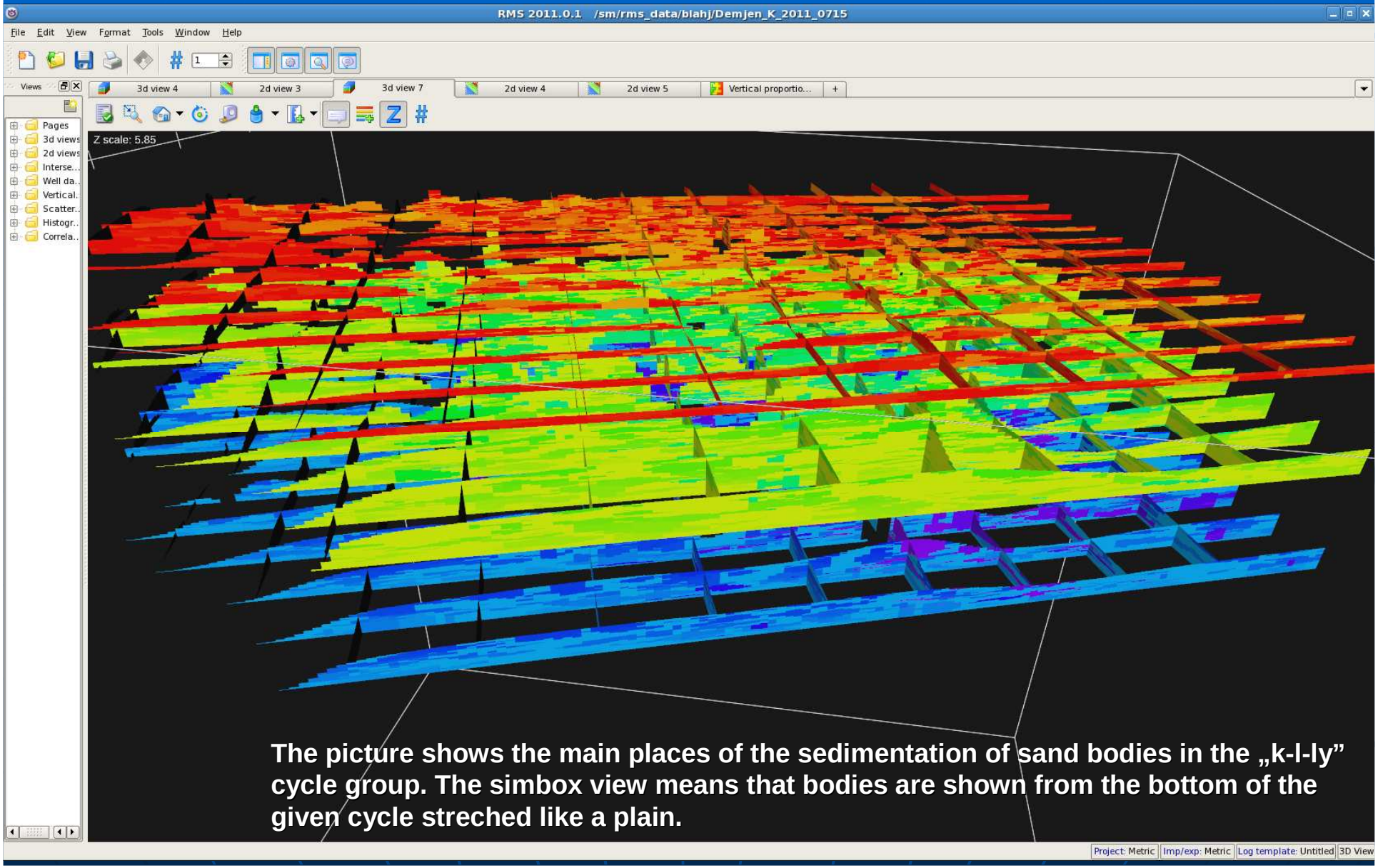


The statistics of the thickness of sand bodies in the turbidite cycles particularly around 2-3 m with a wide range, max.18m.

--The picture shows the main parameters of sand bodies in any turbidite cycle and the shapes of the bodies can be looking somehow like this.

Object based modelling of Demjén Fields

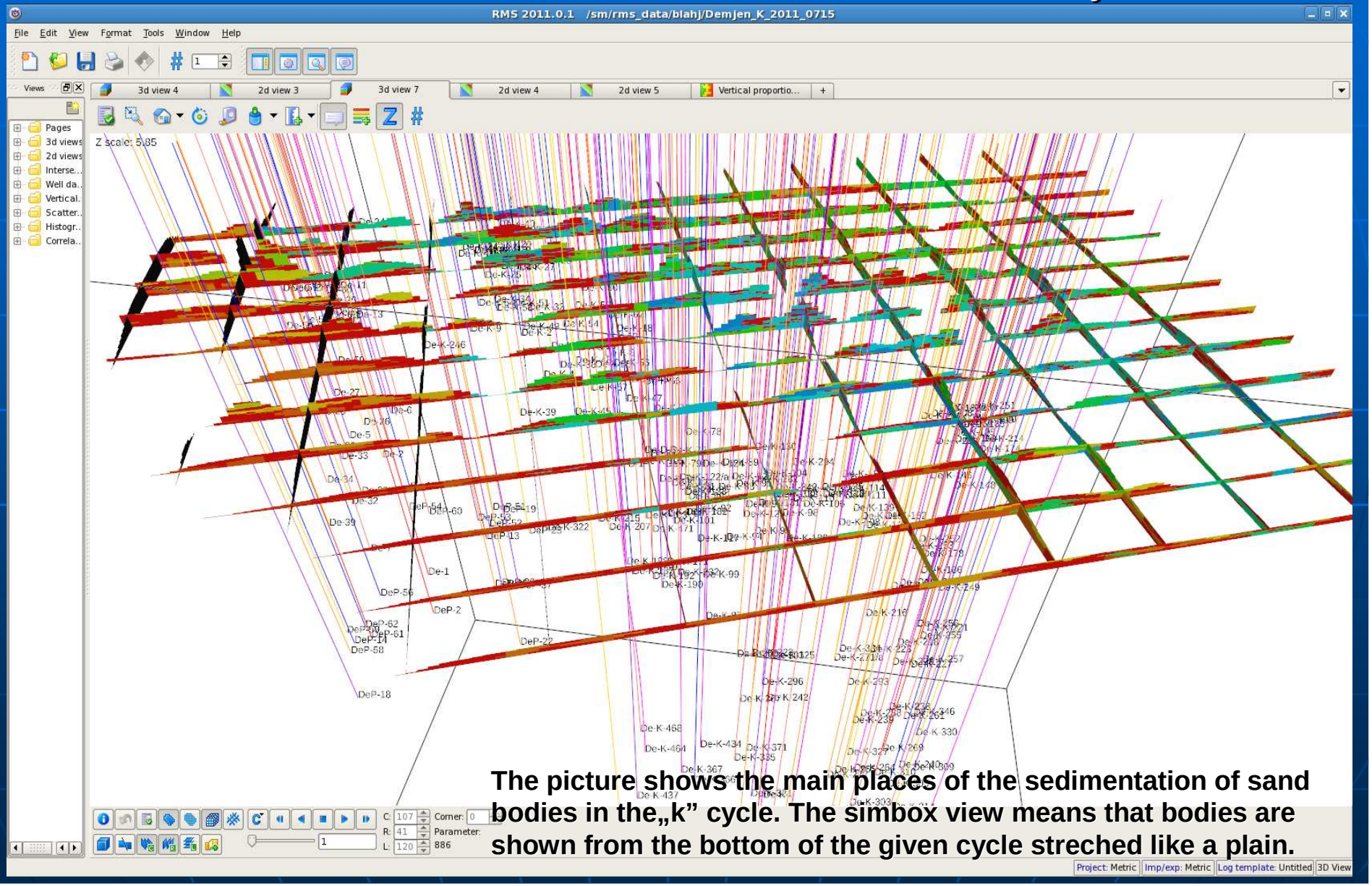
3D fence view of simbox of the „k”-”l”-”ly” turbidites



The picture shows the main places of the sedimentation of sand bodies in the „k-l-ly” cycle group. The simbox view means that bodies are shown from the bottom of the given cycle streched like a plain.

Object based modelling of Demjén Fields

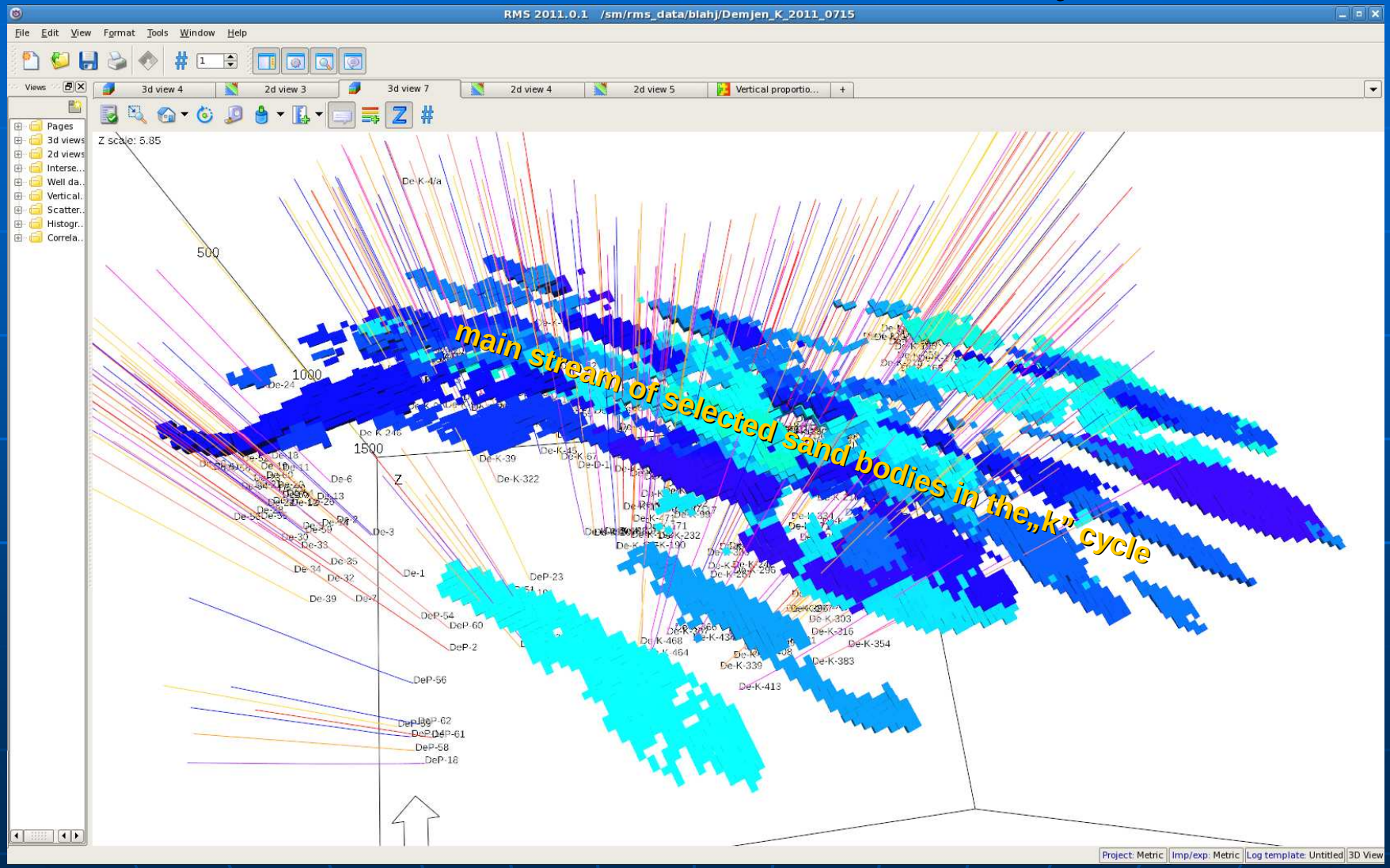
3D fence view of simbox of the „k” turbidite cycle



The picture shows the main places of the sedimentation of sand bodies in the„k” cycle. The simbox view means that bodies are shown from the bottom of the given cycle streched like a plain.

Object based modelling of Demjén Fields

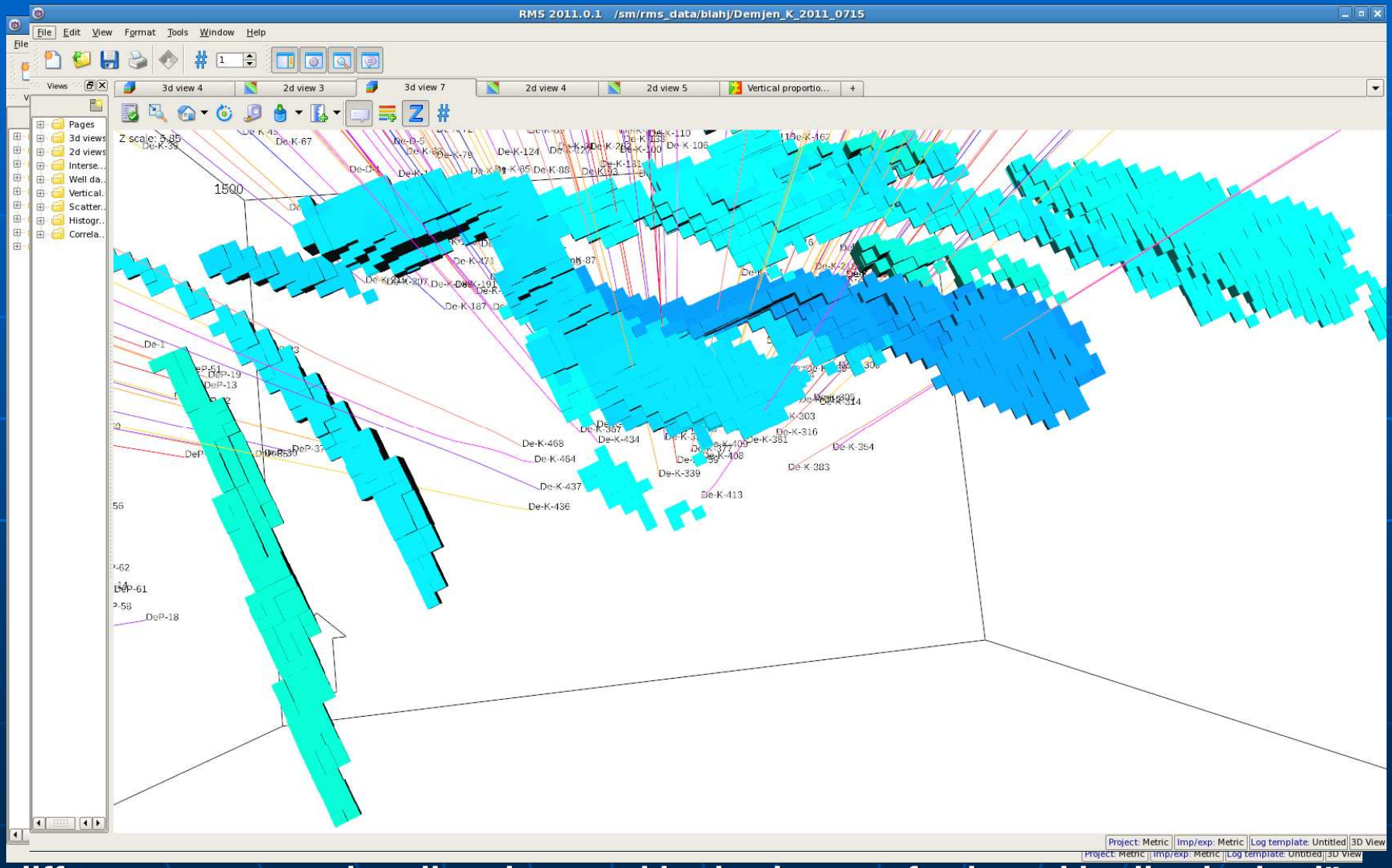
Some set of bodies in „K” turbidite cycle



unique transportation directions and body shapes of selected bodies in the„k” cycle

Object based modelling of Demjén Fields

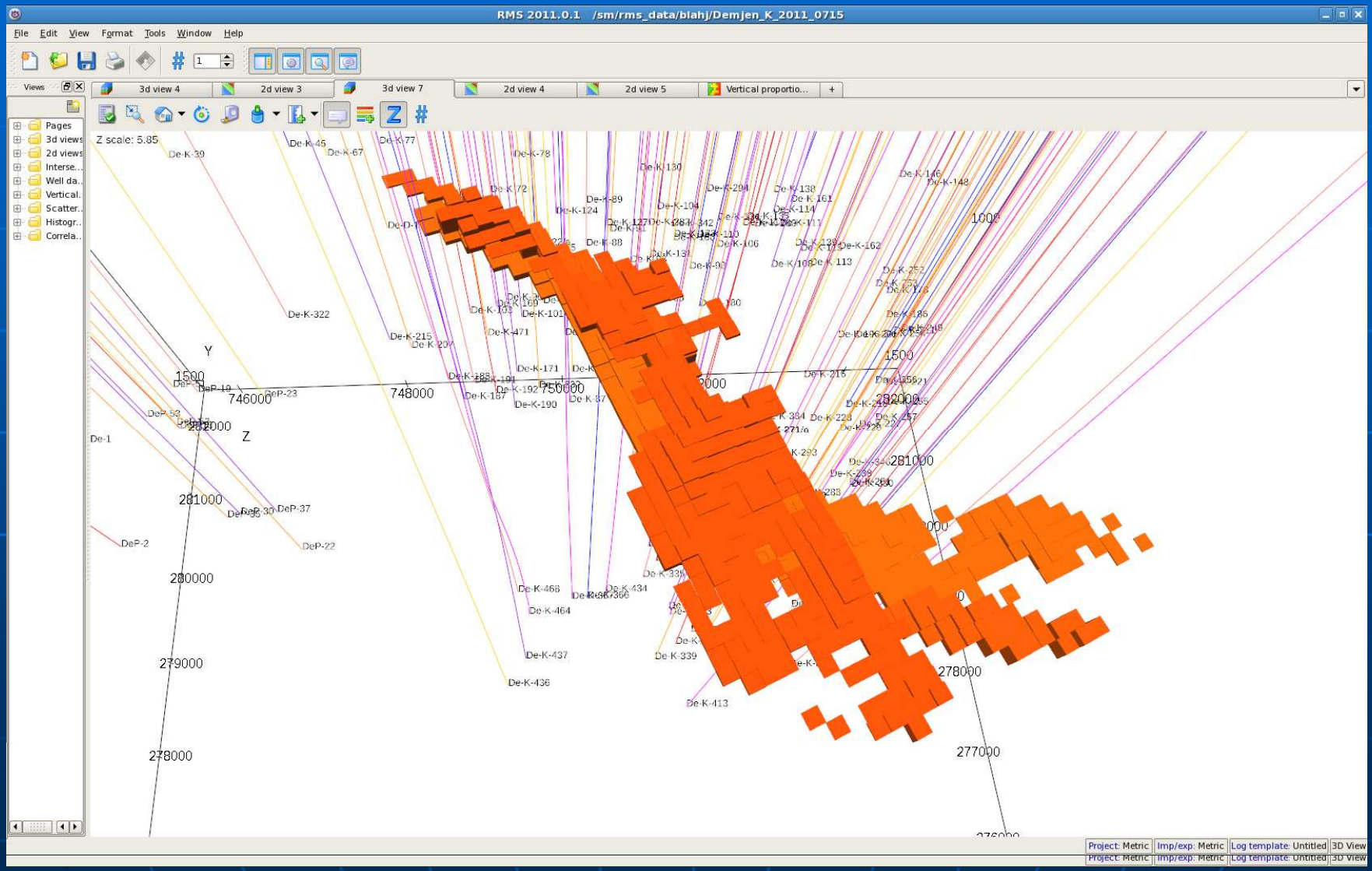
Some set of bodies in „l” turbidite cycle



different transportation directions and body shapes of selected bodies in the„l” cycle

Object based modelling of Demjén Fields

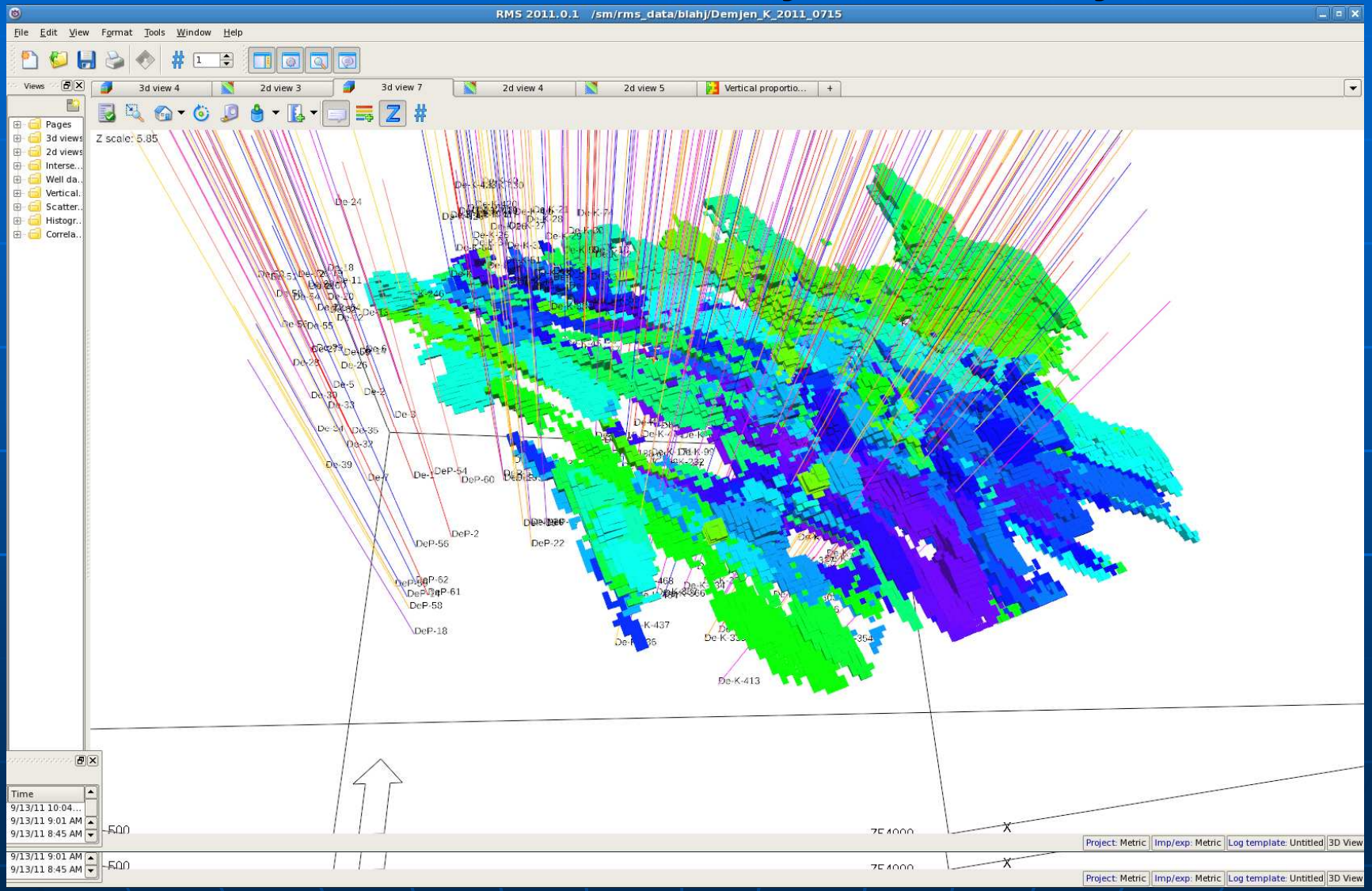
a beauty of object based modelling in „I” turbidite cycle



Three of sandbodies aggregated into one lobe in „I-” turbidite cycle

Object based modelling of Demjén Fields

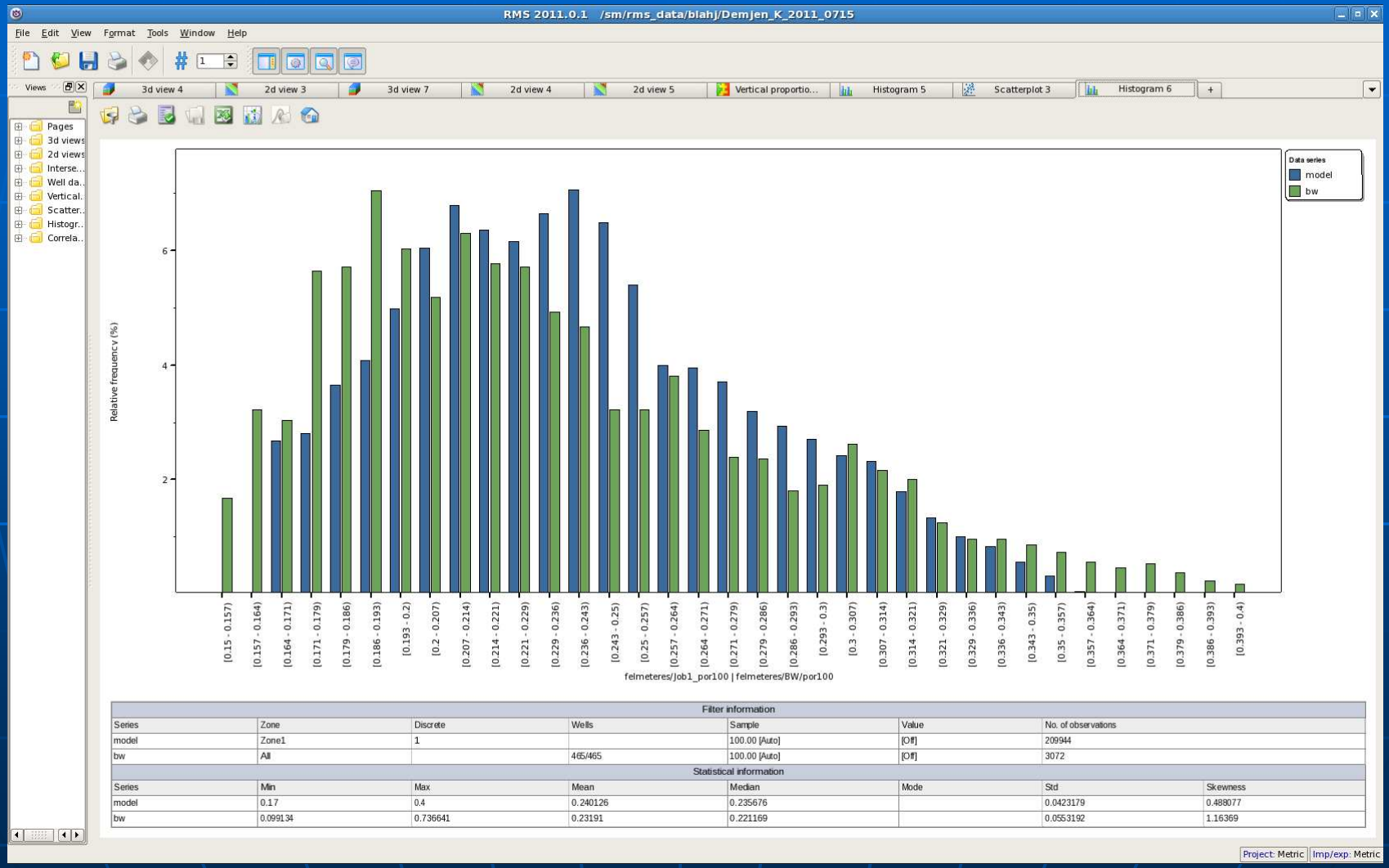
Some set of bodies in „ly” turbidite cycle



animation from a set of pictures about sandbodies sequenting over each other in the„ly” cycle

Object based modelling of Demjén Fields

Petrophysical modelling based on the composite model



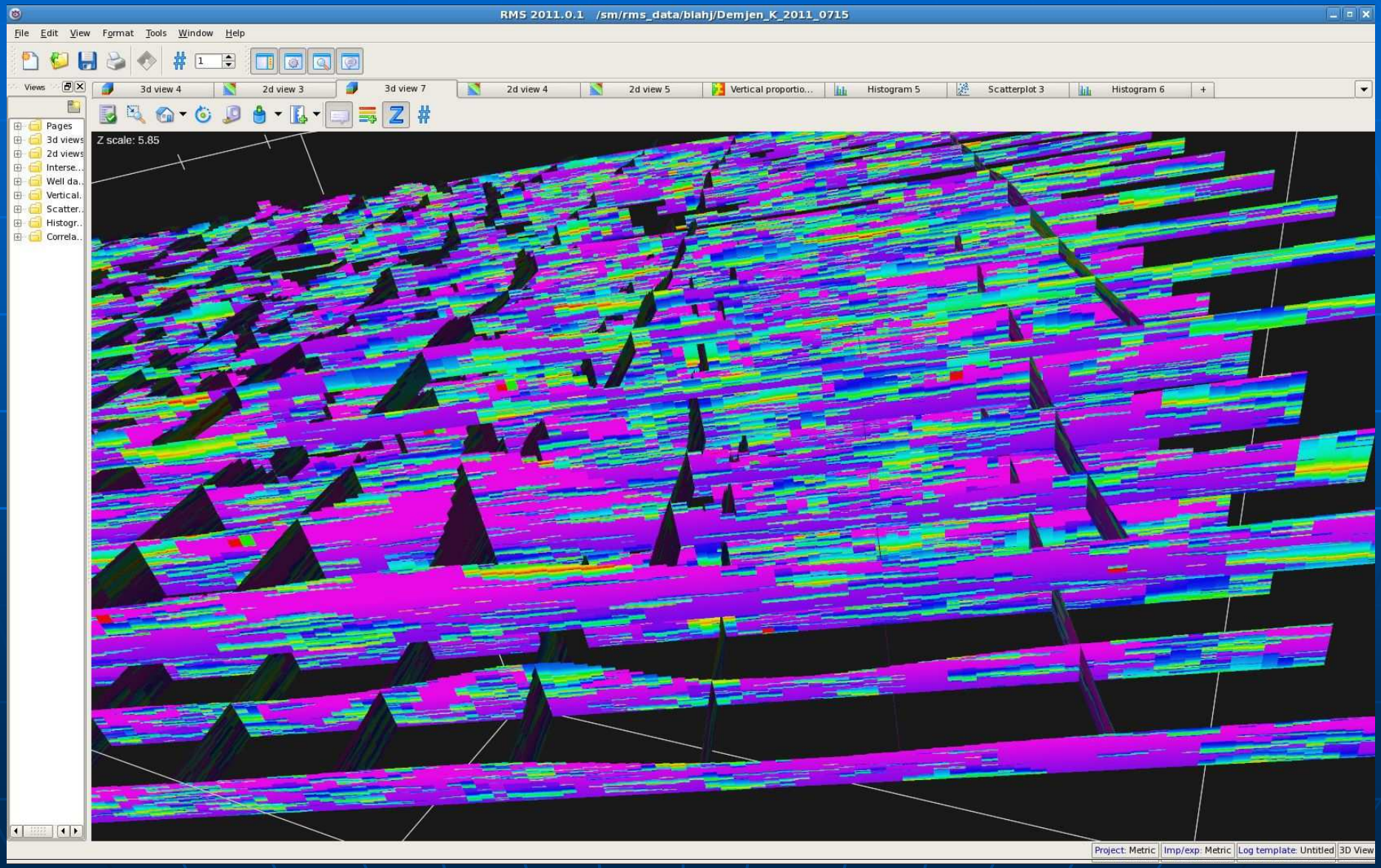
Series	Zone	Discrete	Wells	Sample	Value	No. of observations
model	Zone1	1		100.00 [Auto]	[Off]	209944
bw	All		465/465	100.00 [Auto]	[Off]	3072

Series	Min	Max	Mean	Median	Mode	Std	Skewness
model	0.17	0.4	0.240126	0.235676		0.0423179	0.488077
bw	0.099134	0.736641	0.23191	0.221169		0.0553192	1.16369

Porosity from the model and from blocked wells are in correlation in „k-l-ly” group

Object based modelling of Demjén Fields

Porosity model fence views: total, sandbody zoomed, turbidite fan of „k-l-ly” group



Object based turbidite modelling of Demjén Fields