Controls on the distribution and thickness of Permian basal Upper Rotliegend sandstones, the Netherlands:
probing the limits of the Rotliegend play area

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What are the controls on the Upper Rotliegend sandstone distribution? Two areas have been investigated in detail:

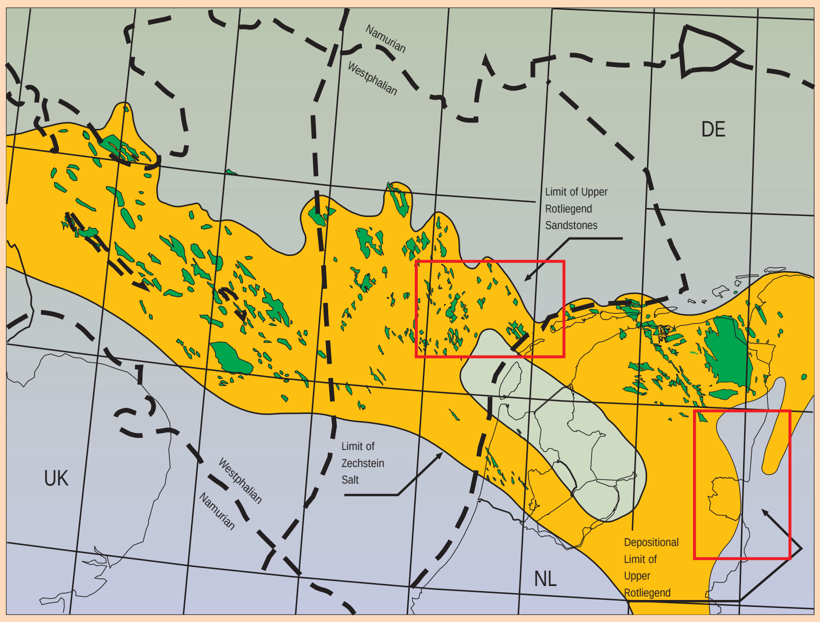

Figure 1 Outline Rotliegend play area

Figure 2 Carboniferous/Permian stratigraphy

1. Eastern Netherlands study area

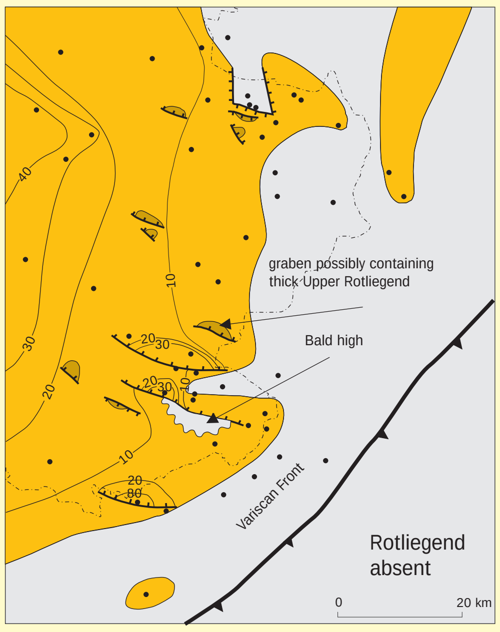

Figure 3 Strong thickness variation; bald highs with no Upper Rotliegend and adjacent thick occurrences.

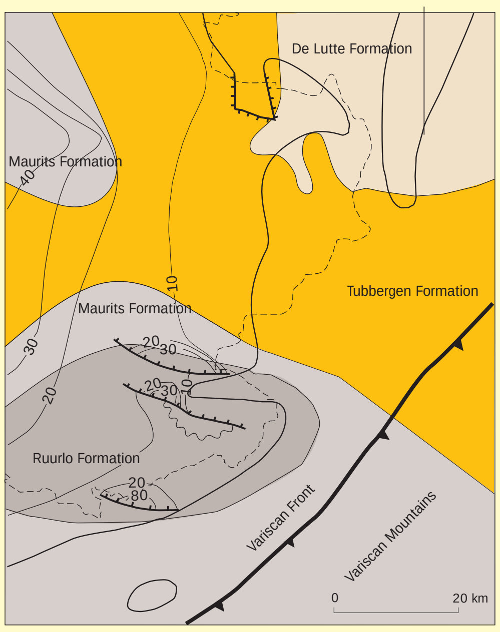

Figure 4 No relation between thickness and Carboniferous subcrop; Variscan Front delineates the distribution

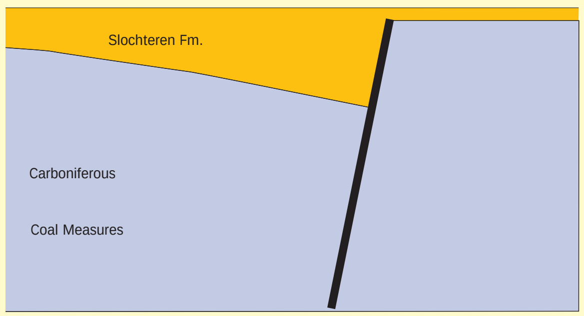

Figure 5 Model: Fault-bounded topography

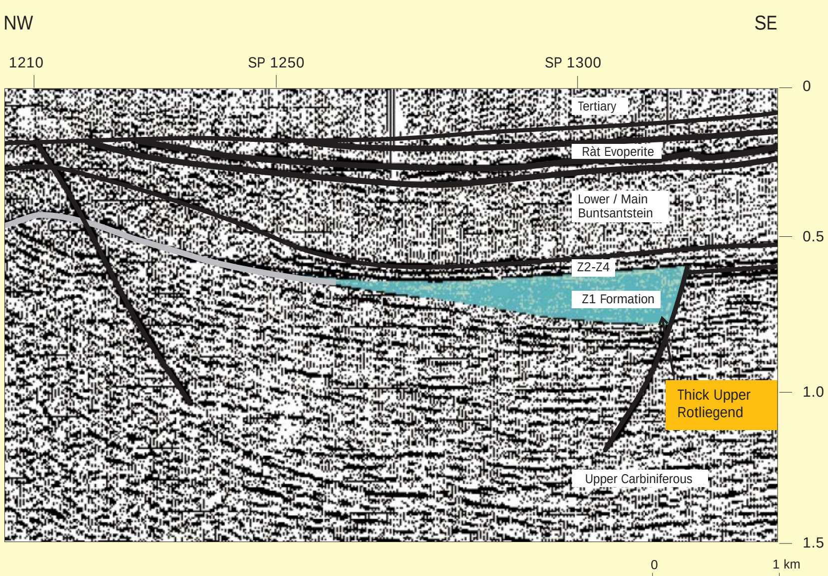

FIG 6 Active faults in the vicinity of the Variscan Front; fault movement in relation to Permian wrench tectonics. Rotliegend grabens can be identified based upon enhanced Zechstein (Z1) subsidence pattern and fault reactivation.

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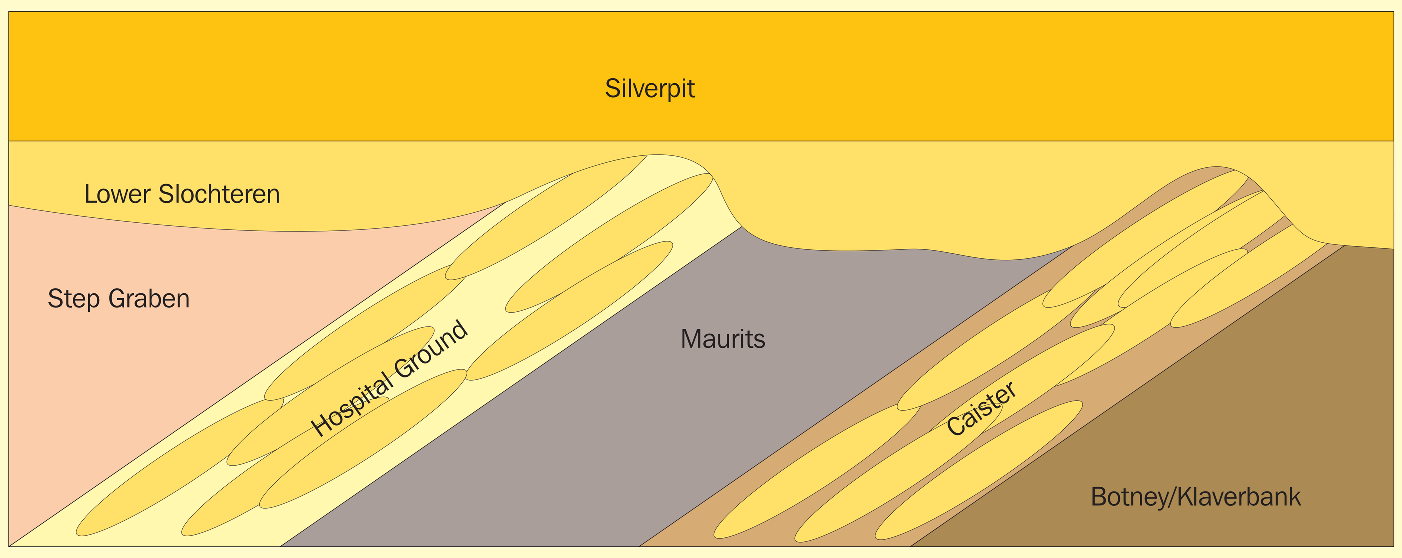

Figure 1: Schematic cross-section depicting the depositional model of the Lower Slochteren sandstone at the northern limit of the Rotliegend play area

2. NW offshore study area

The model: Subcrop-related thickness distribution of the Lower Slochteren sandstone (figure 1).

On top of the regional thinning of Upper Rotliegend sediments towards the Cleaver Bank High, the thickness and distribution of the Lower Slochteren sandstone was governed by the topography at the onset of its deposition. This pre-depositional erosional surface is related to the lithology (the lithostratigraphic unit) and the structural dip of the subcropping Carboniferous units (figure 2). Dipping sand-prone, resistant units like the Hospital Ground Formation and the Botney Member (including the Caister Sandstone) formed topographical heights resulting in a cuesta landscape (figure 1).

Softer, claystone-dominated formations like the Maurits and the Step Graben Formation formed topographical lows. The topography is expected to be in the order of 20 to 50 m. In the lows accommodation space for sandy sediments existed, which are either fed by fluvial streams or wind-blown from the east.

The result is a thick Lower Slochteren sandstone in the topgraphical lows in contrast to a thin or no Lower Slochteren sandstones on the highs.

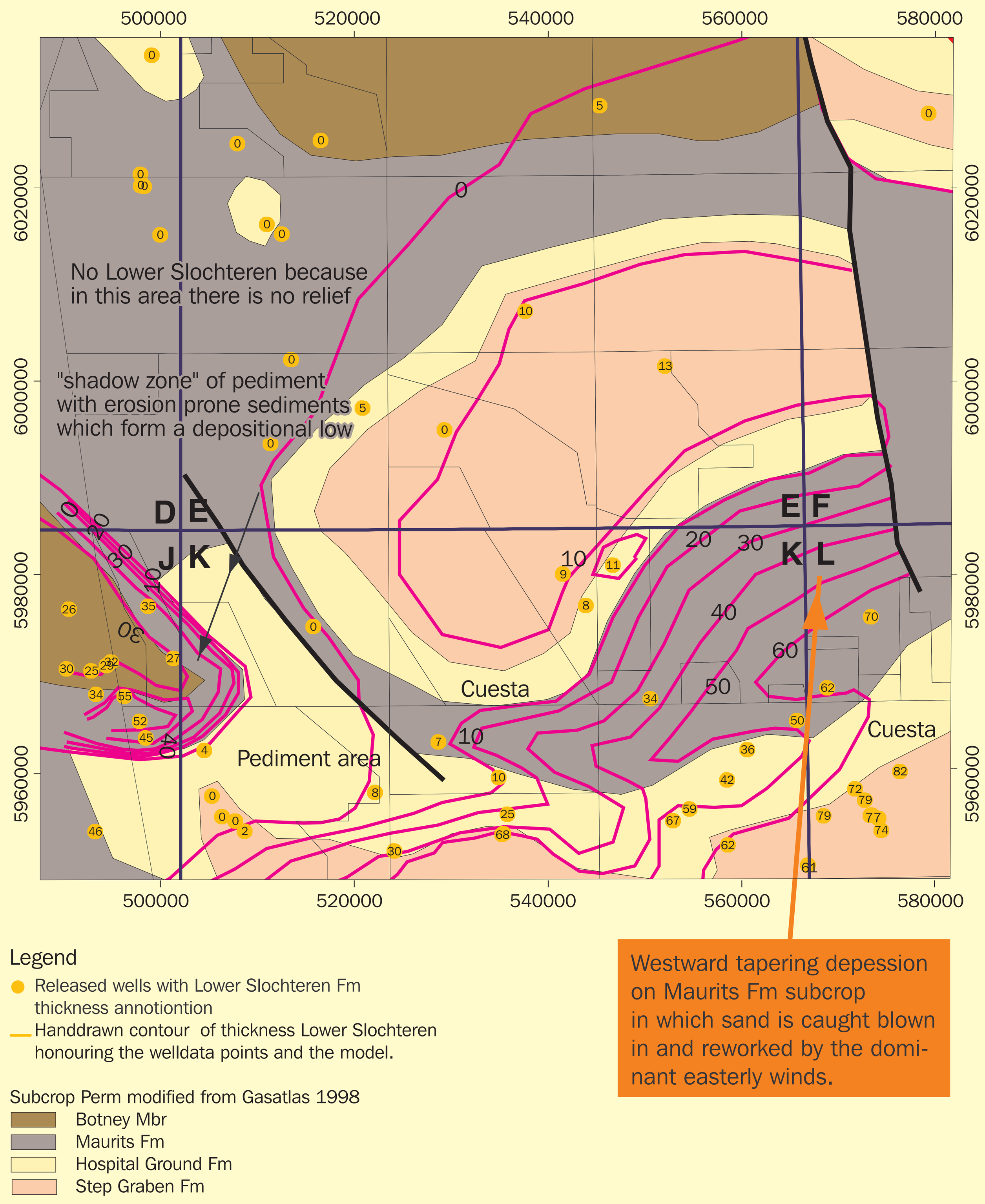

Figure 4: The Lower Slochteren sandstone distribution manually contoured using well data (released wells) and the geological model

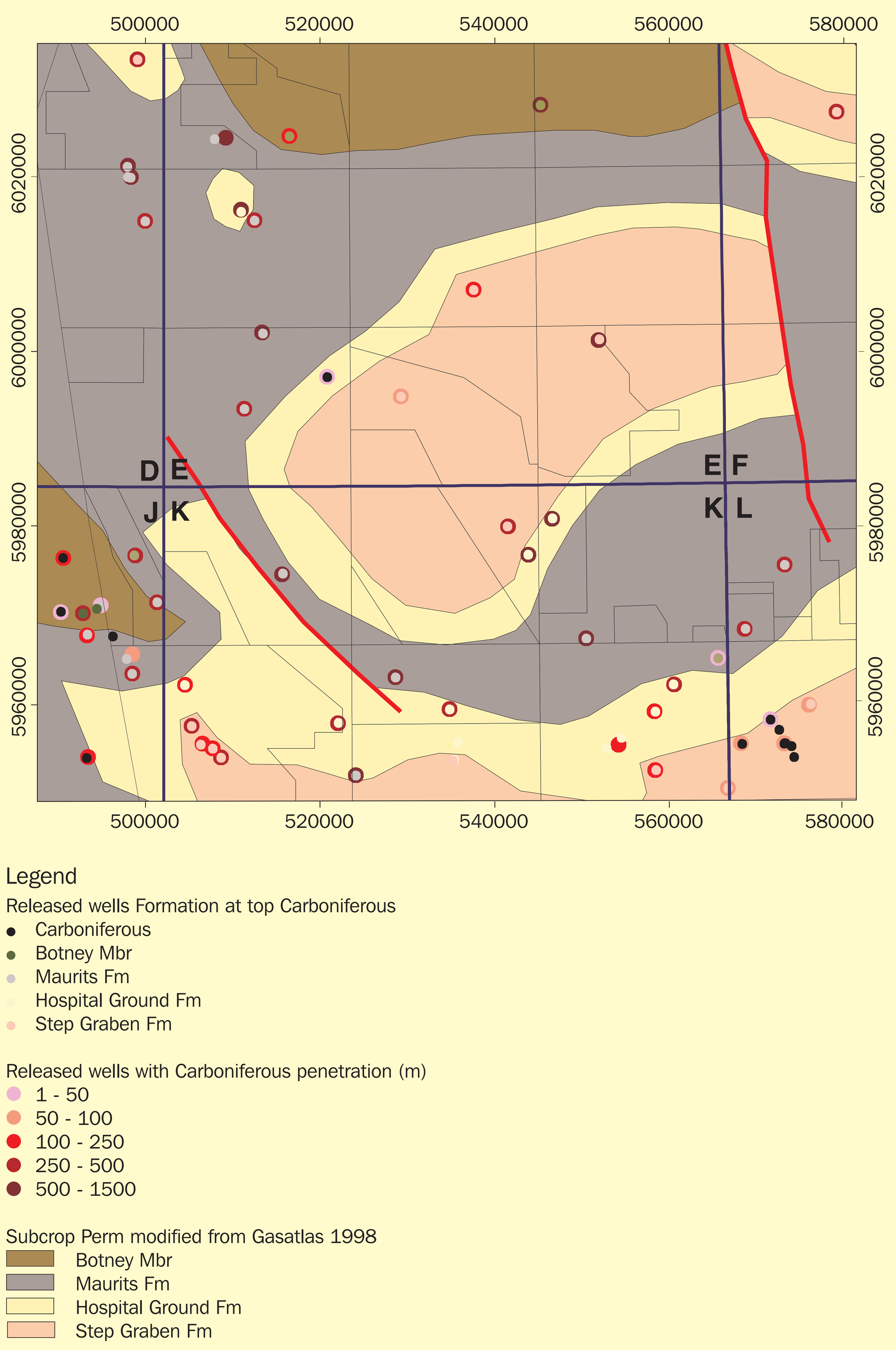

Figure 2: The Permian subcrop map of the study area (after NW European Gasatlas 1998 and Van Adrichem Boogaert & Kouwe 1993 figure C4)

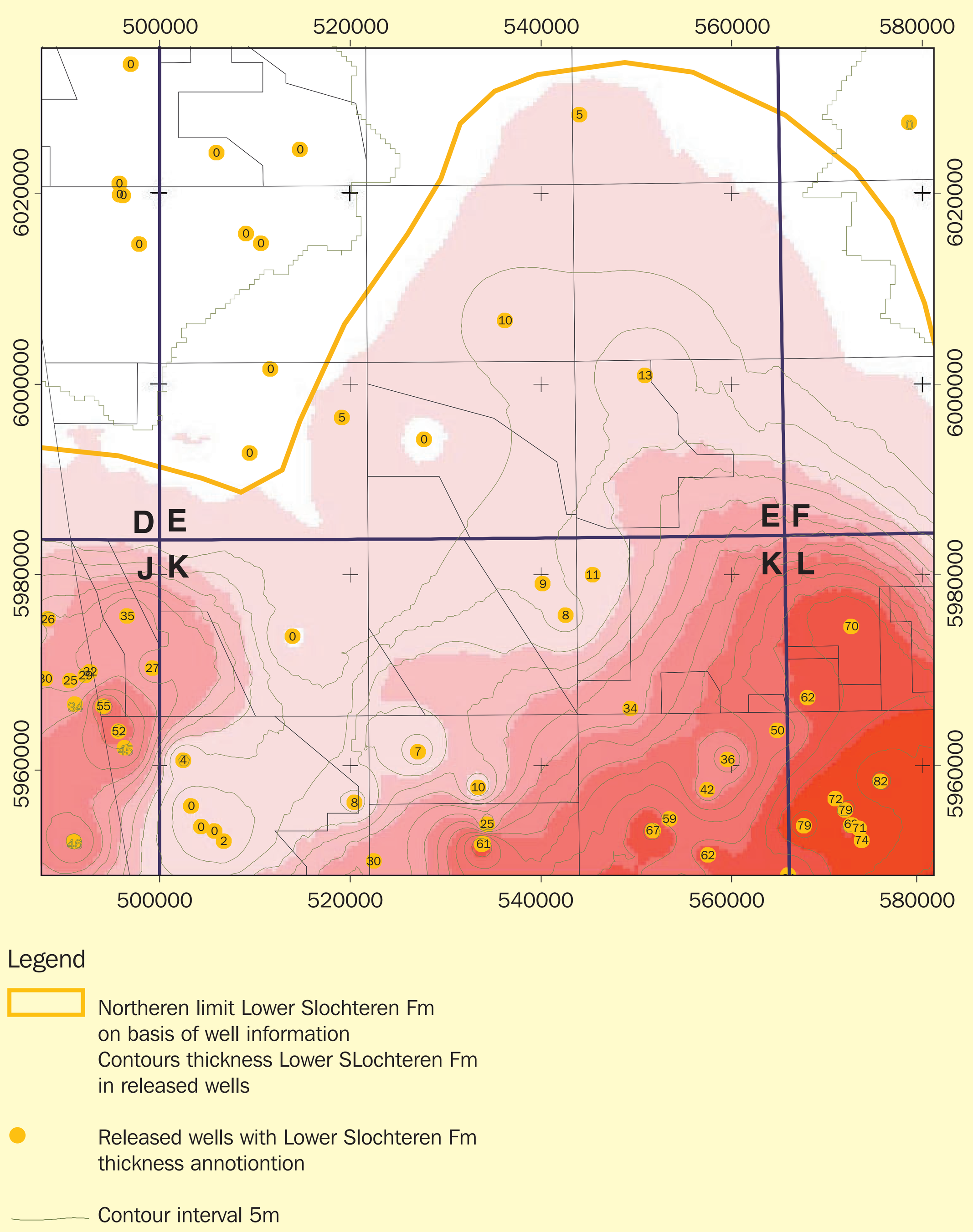

Figure 3: The Lower Slochteren sandstone distribution in wells (released wells) contoured automatically without using the geological model

Conclusion

Although both the automatic (figure 3) and manual contouring (figure 4) honor the well data the resulting pattern is quite different.
The manually contoured map better explains the occurrence and absence of the Lower Slochteren.
The thin Lower Slochteren sandstone area in blocks K1 and K4 was related to a relative high or pediment of the sandy Hospital Ground Formation. The thick Lower Slochteren in the Markham area is related to the depression of the Maurits Formation.

In areas with few wells as the southern E and northern K blocks the model may prove predictive.
Within relative lows created by the Step Graben and Maurits Fm bordered by the cuestas of the Hospital Ground Fm relatively thick Lower Slochteren may be present.
When using a more detailed subcrop map based on 3D seismic interpretation and calibration using the well data the thickness of the Lower Slochteren can be predicted with more certainty.