The Query tool

The Query tool, found on the Data & Analysis tab in Move™, provides advanced methods for interrogating and filtering data. Query selections can be performed using any object attribute or on spatial relationships of, or between, objects in the model. Further modelling operations can then be applied to the results of the query. In this monthly feature, the Query tool is first used to carry out quick editing of a model derived from a North Sea dataset that would otherwise be very time consuming (Figure 1), then it is used to efficiently highlight the most suitable location for a well that intersects the reservoir.
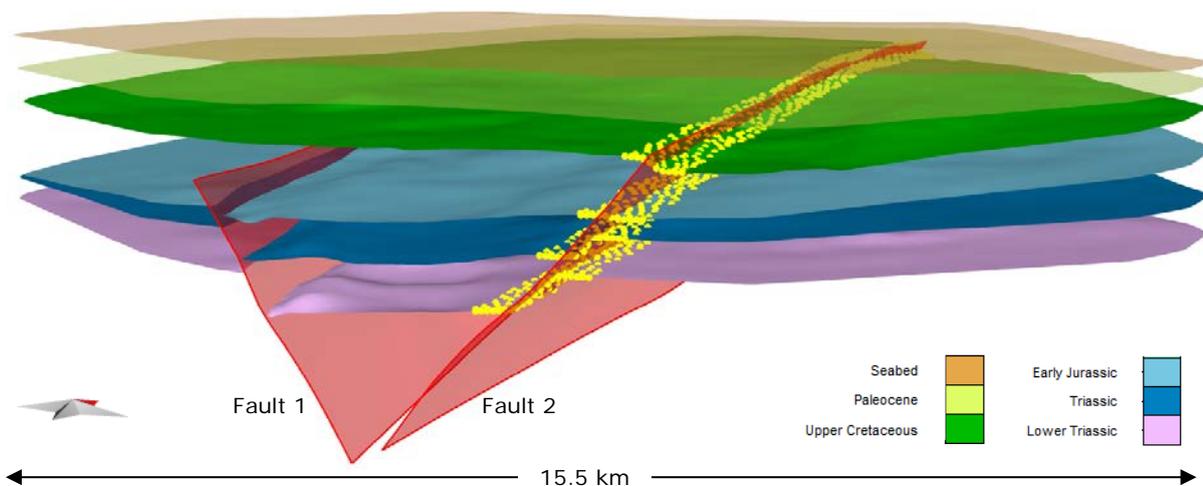

Figure 1: Model derived from a North Sea dataset. Surfaces filtered using the Query tool for locations where the distance to Fault 2 is <300 m. Yellow points correspond to the selected vertices.

The model consists of Triassic to Upper Cretaceous horizons cut by normal faults (Fault 1 and Fault 2) one of which shows evidence of inversion (Fault 2), Paleocene and Seabed horizons postdate fault activity. The Triassic horizon represents the top of the main reservoir, and is bounded to the East by Fault 2.

The horizon surfaces are correctly split by Fault 1. However, as displayed in Figure 1, these horizons are not split by Fault 2. This is not a realistic hanging wall and footwall geometry for Fault 2 and needs to be adjusted. The Query tool can be used to quickly correct this.

To start the query, objects to be interrogated or filtered must be selected. These can be whole objects, vertices, faces, cells or well markers.

1. From the **Data & Analysis** tab, open the **Query** tool.

2. Under **Selection Data Type**, select **Vertices** and collect the horizon surfaces into **Collected Objects**, as displayed in Figure 2.
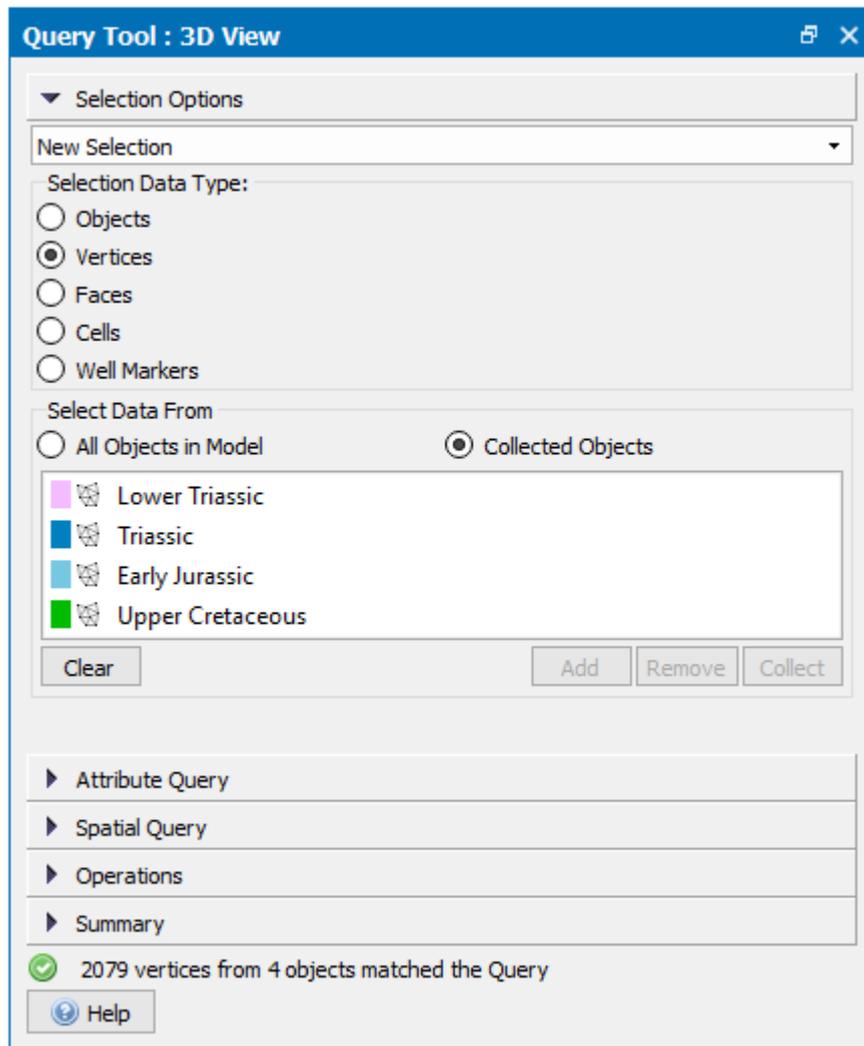
Figure 2: Vertices from the horizon surfaces selected for Query interrogation.

Spatial Query

To edit the horizons around Fault 2, the surface vertices located <300 m from Fault 2 will be selected using Spatial Query in the Query tool. The filtered vertices will then be deleted, and the hanging wall and footwall surfaces will be snapped to the fault. As displayed in Figure 3, various spatial queries are available in Move, including Within Distance, Closest to Vertex, Directly Above, Directly Below, In Direction, Inside Bounding Box and Inside Polygon. In this case, the most appropriate spatial relationship to use is the Within Distance method.

3. Select **Within Distance** as the **Spatial Relationship**, as shown in Figure 3.
4. Collect **Fault 2** into the **Source Data** box.
5. Set the **Distance** to **300** m and click **Apply**.

The applied query will select all vertices <300 m away from Fault 2, as displayed in Figure 1.

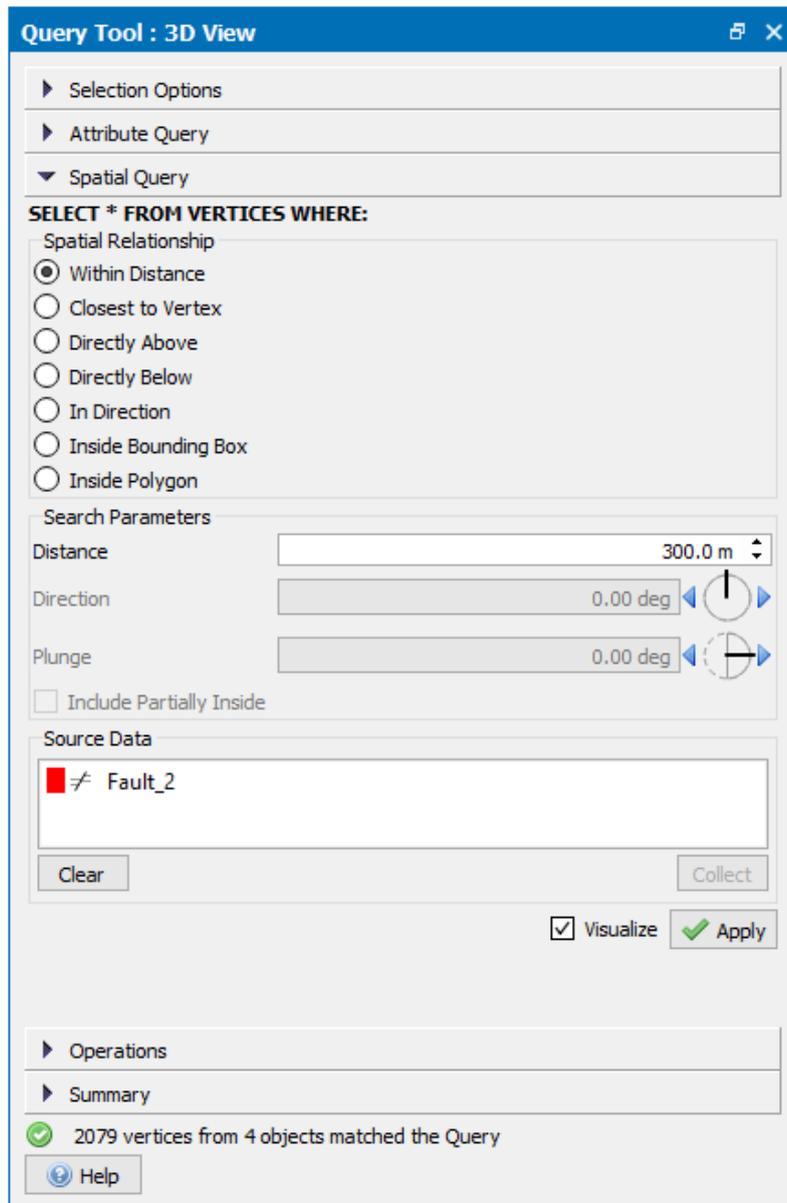6. To delete the corresponding surface parts, press Delete on your keyboard.

Figure 3. Spatial Query configuration for selecting vertices <300 m away from Fault 2.

Snap for model conditioning

The Snap tool will now be used to reconstruct the deleted parts of the horizons, and ensure that they are tight against the fault surface.

7. Select the four horizon surfaces, right-click and select **Separate Mesh** from the context menu, as displayed in Figure 4.
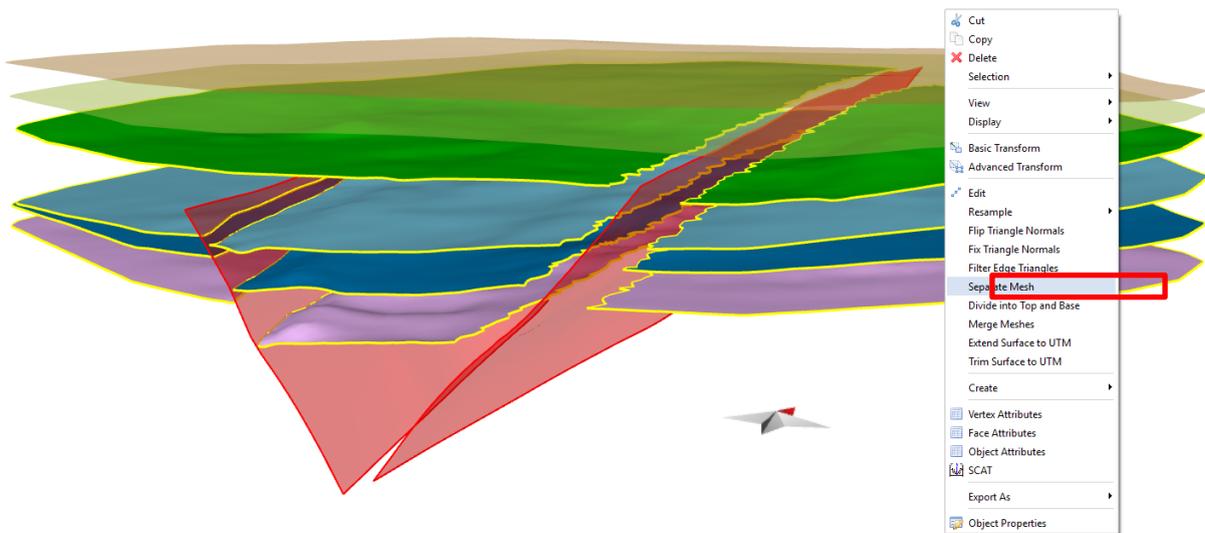
Figure 4. Separating meshes of Lower Triassic, Triassic, Early Jurassic and Upper Cretaceous. Separate Mesh is highlighted on the context menu by red rectangle.

8. From the **Model Building** tab, open the **Snap** tool.
9. Collect one of the horizons into the **Source Surfaces** box and **Fault 2** into the **Target Surfaces** box. Figure 5 displays the toolbox set up for the Upper Cretaceous footwall. If necessary, use **Edit Source/Target Lines** to adjust the extent of the area to be snapped (tab highlighted with red rectangle in Figure 5). Once adjusted, the previewed area to be snapped will look like Figure 6.
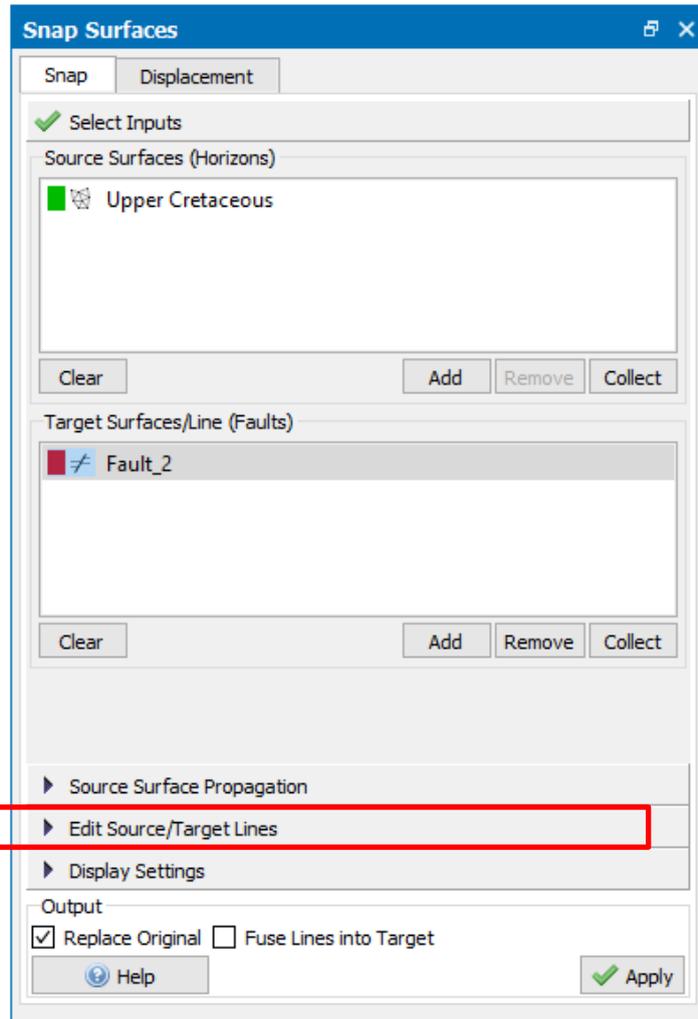
Figure 5. Snap toolbox set up for snapping Upper Cretaceous footwall to Fault 2.
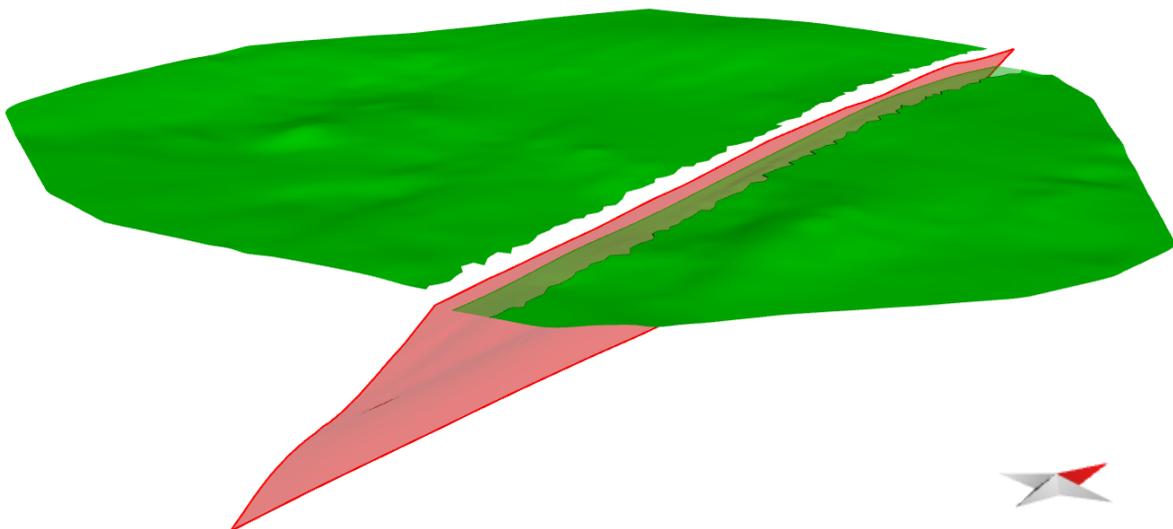

Figure 6. Preview of the Upper Cretaceous footwall area to be snapped to Fault 2.

10. Apply the Snap as specified using the toolbox and repeat the operation for the other surfaces.

Lower Triassic, Triassic, Early Jurassic and Upper Cretaceous surfaces will now be in a watertight relationship with Fault 2, as displayed in Figure 7.
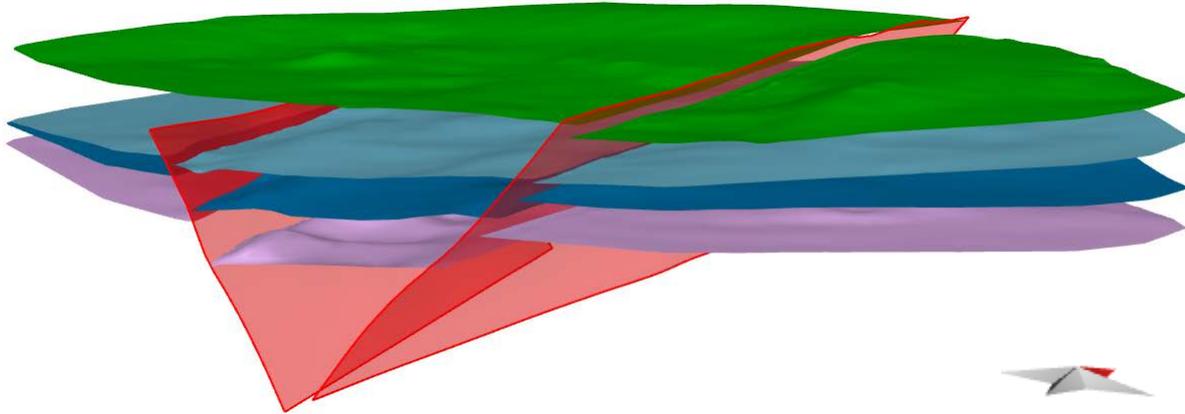

Figure 7. Hanging wall and footwall horizons snapped to Fault 2, honouring its offset. Seabed and Paleocene surfaces are hidden in this figure.

Attribute Query

The Query tool can be used to filter objects, or parts of objects based on their attributes. With the Query tool, logical and string operations provide a powerful way of selecting or interacting with objects.

In this model, the optimum drilling location for a planned well has been identified as where the reservoir unit thickness is maximum (>1000 m) and the top horizon depth is minimum (elevation > -1900 m). This can be quickly determined using thickness analysis and Attribute Query.

1. From the **Data & Analysis** tab, open the **Surface Geometry** tool.
2. As shown in Figure 8, under **Property to Analyse**, select **Thickness**, collect Triassic HW as the **Source Surface**, collect Lower Triassic HW as the **Target Surface**, click on the **Attribute Creation** option and click **Create Vertex Attribute**.

This will calculate the thickness of the Triassic reservoir unit in the hangingwall of Fault 2.
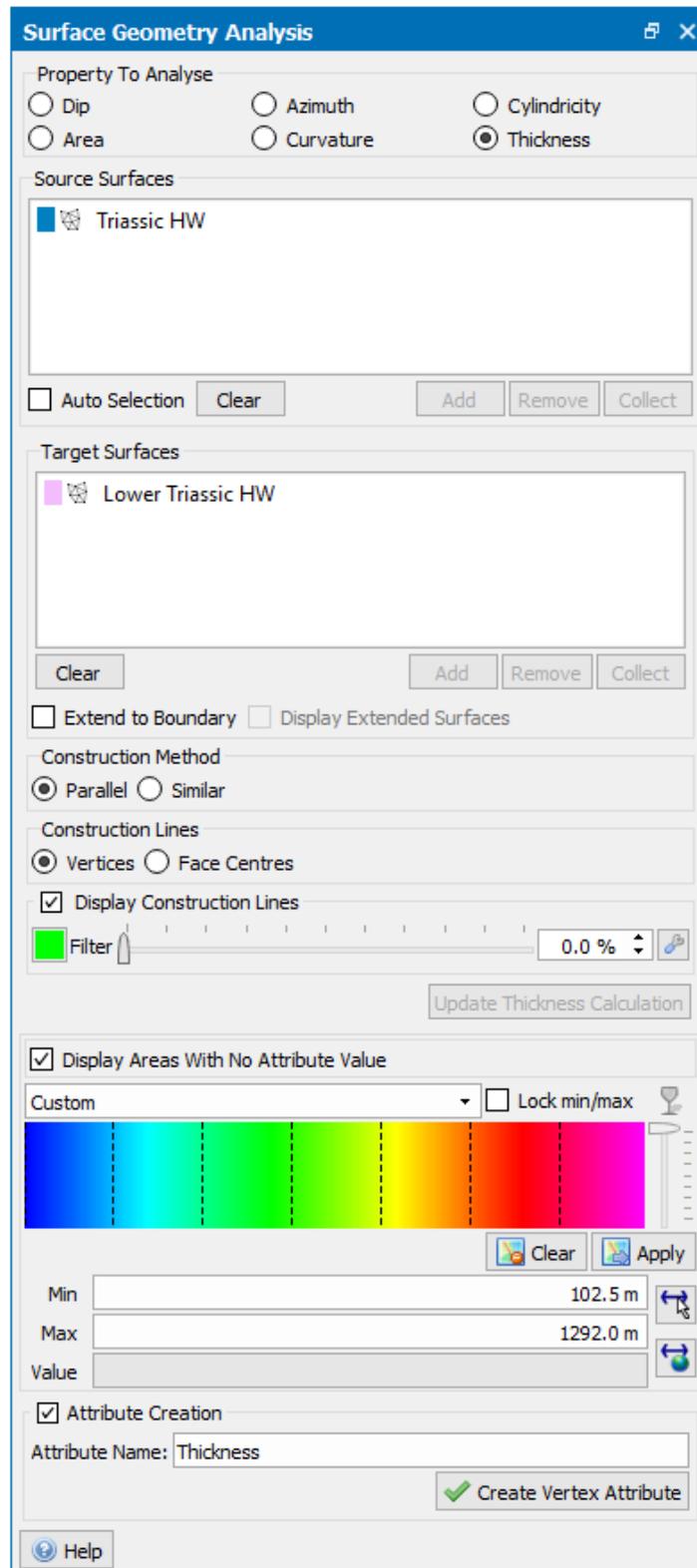
Figure 8. Surface Geometry Analysis window with options selected to calculate Triassic HW thickness.

3. From the **Data & Analysis** tab, open the **Query** tool.
4. On the **Selection Options** tab, under **Selection Data Type**, choose **Vertices** and collect Triassic HW into the **Collected Objects** box.

5. Click the **Attribute Query** tab.
6. Using the calculator buttons in the tool or typing directly from your keyboard, enter the expression **"THICKNESS" > 1000 AND "Z" > -1900** in the **SELECT * FROM VERTICES WHERE** box. This is highlighted in Figure 9 by a red rectangle. Then click the green tick to apply the query.
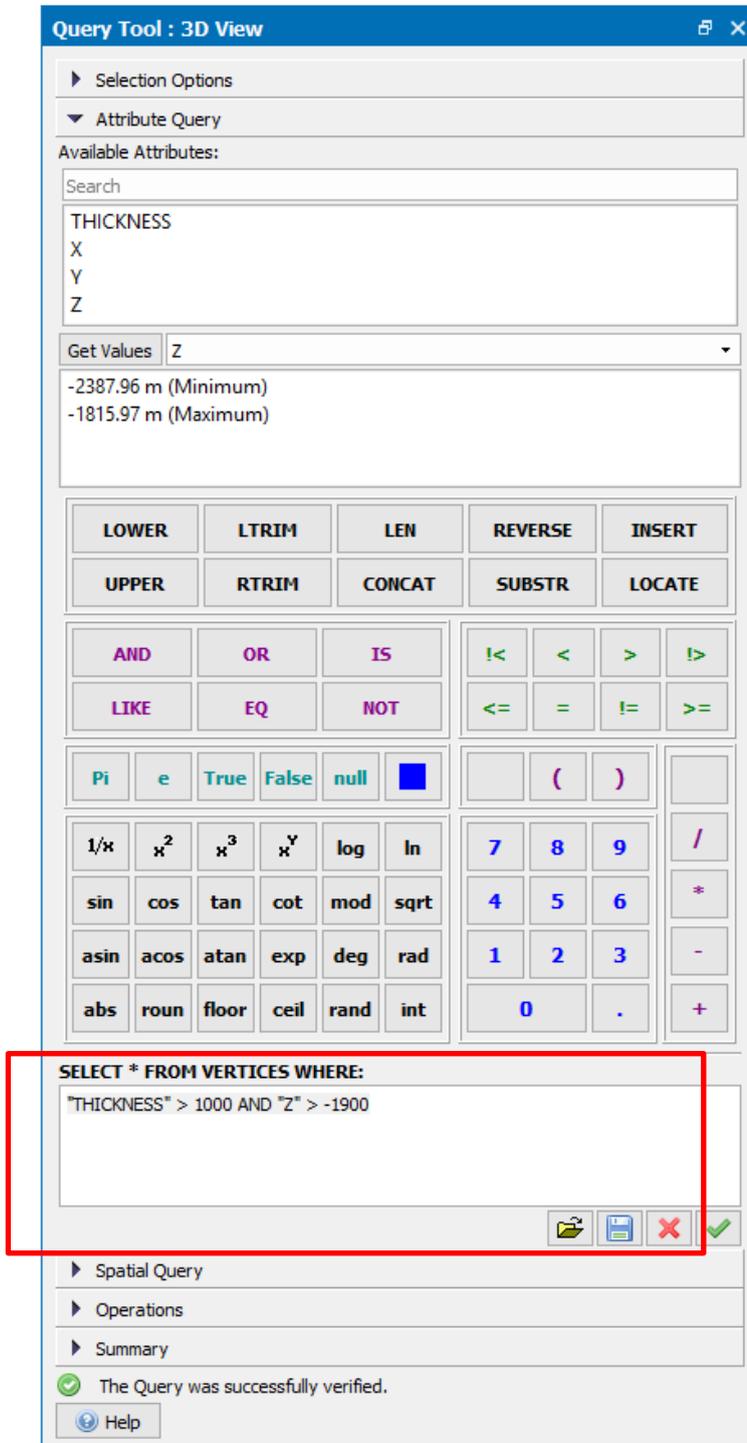

Figure 9. Setting up the Attribute Query on Triassic HW to select vertices where the unit thickness is >1000 m and the elevation is > -1900 m.

The vertices that fullfil the requirements introduced in the query will be highlighted, as displayed in Figure 10. These represent the most suitable location for a well that intersects the Triassic reservoir interval.
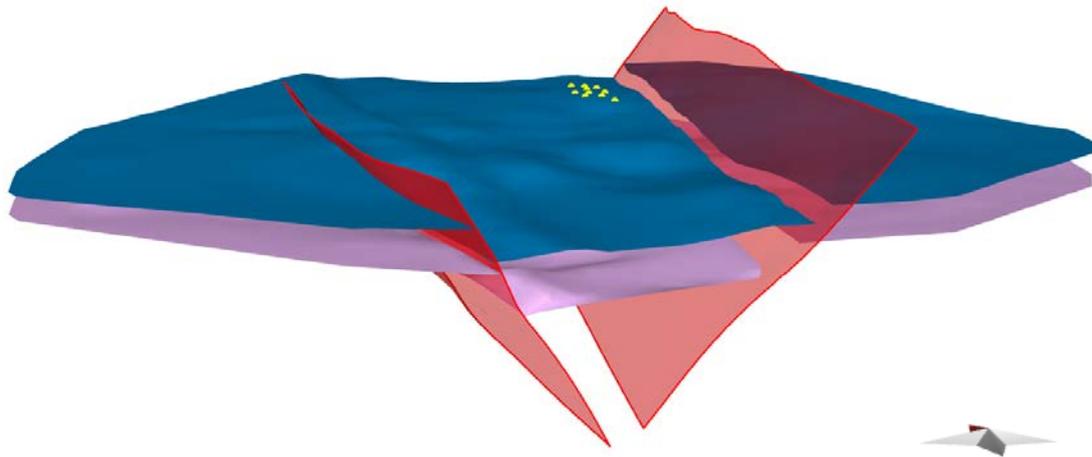

Figure 10. Result of Triassic HW queried for vertices where thickness is > 1000 m and elevation is > -1900 m. Only Lower Triassic and Triassic horizons displayed.

A range of filtering and selection operations can be conducted on the selected objects, depending on the query type. In this case, it is useful to record the best area for drilling the well by converting the selection to a new vertex cloud, which will exist as a permanent object in the model.

7. In the **Query** tool, click the **Operations** tab and click **Create Vertex Cloud** (Figure 11).
8. Name the new vertex cloud and click **OK**. The area will become a permanent point set.
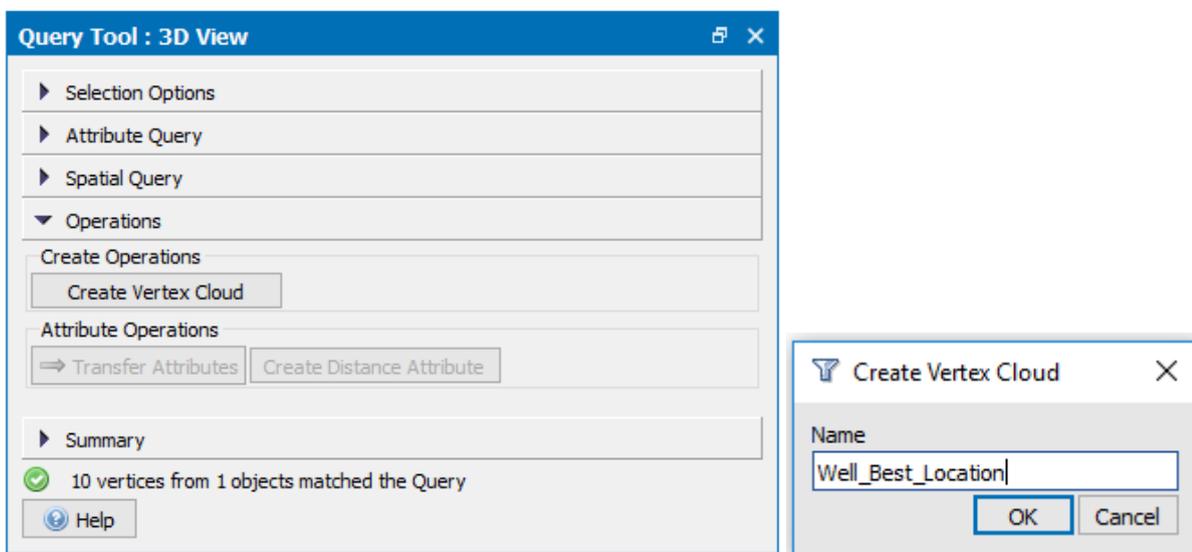

Figure 11. A new object can be created from a Query, clicking Create Vertex Cloud in the Operations tab and naming the new vertex cloud.

If you require any more information about **Move**, then please contact us by email: enquiries@mve.com or call: +44 (0)141 332 2681/+44 (0) 131 4747030.