

**SYMBOL LEGEND**

<b>Total dissolved solids (mg/L)</b>	<b>Well data point</b>
620 - 2 000	Hydrocarbon dominated flow zone; hachure points into flow zone
2 001 - 4 000	Eastern limit of main Cordilleran deformation
4 001 - 6 000	Non-saline/saline boundary (4 000 mg/L)
6 001 - 8 000	Cross-section line
8 001 - 12 000	
12 001 - 18 000	

This map depicts the concentration of total dissolved solids (TDS) in groundwater in the Wapiti / Belly River hydrostratigraphic unit (HSU). The horizontal and vertical extent of mapping was determined from the lithostratigraphy and hydraulic properties of the undivided Wapiti Formation in the west-central plains and the Belly River Group in the east-central and southern plains (Figure 1). These two regional units were considered as a single HSU and the hydrogeological data were combined to develop this map. The thickness of the formations varies between the undivided Wapiti Formation and the Belly River Group, as shown in Figure 2, but they are interpreted to be in hydraulic communication and consequently are mapped as one HSU.

**Methodology**

The TDS distribution map is a result of a simple kriging technique using publicly available data from 302 oil and gas wells (Figure 3, left) and 613 water wells (Figure 3, right). Measured TDS values range from 337 mg/L to 23 174 mg/L. Residual values (predicted value minus measured value), are plotted at each location (Figure 3) to indicate where underprediction and overprediction occurs compared to the measured TDS values.

The hydrocarbon-dominated zone is denoted by a hachured grey line on the map. It delineates an area where most of the hydrocarbon production from the lowermost basal Belly River Group and Wapiti Formation occurs and where precaution was taken to eliminate pressures and formation water samples that might be affected by production activities. Delineation of this hydrocarbon zone was based on an assessment of the production wells and pressure regime, in addition to a previous assessment of the underpressured region in the Belly River aquifer by Bachu and Underschultz (1995).

Additional formation-scale hydrogeological maps are shown in Figures 4 and 5 and Singh and Nakevska (2018). Contoured hydraulic heads from water well and drillstem test data are shown in Figure 4, and the water driving force (WDF) vector map is illustrated in Figure 5. The WDF vector map allows identification of areas where formation water density has the potential to change the inferred magnitude and direction of groundwater flow (Singh et al., 2017). The relatively small angles between the WDF vector and hydraulic gradient vector, shown in Figure 5, indicate that there are no significant density effects on groundwater flow due to relatively low TDS values and associated density gradients.

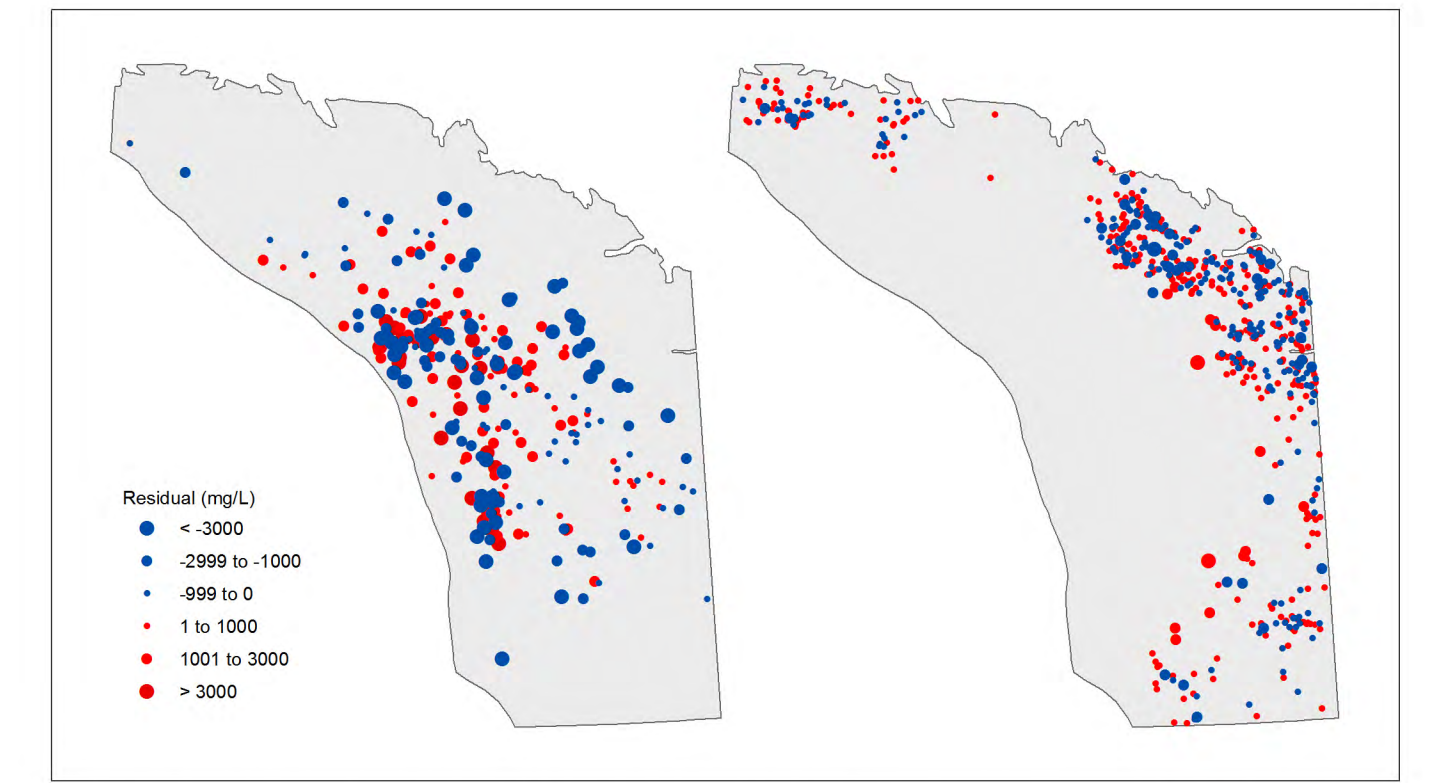


Figure 3. Calculated residuals between the modelled distribution of TDS and measured values for oil and gas well locations (left) and water well locations (right).

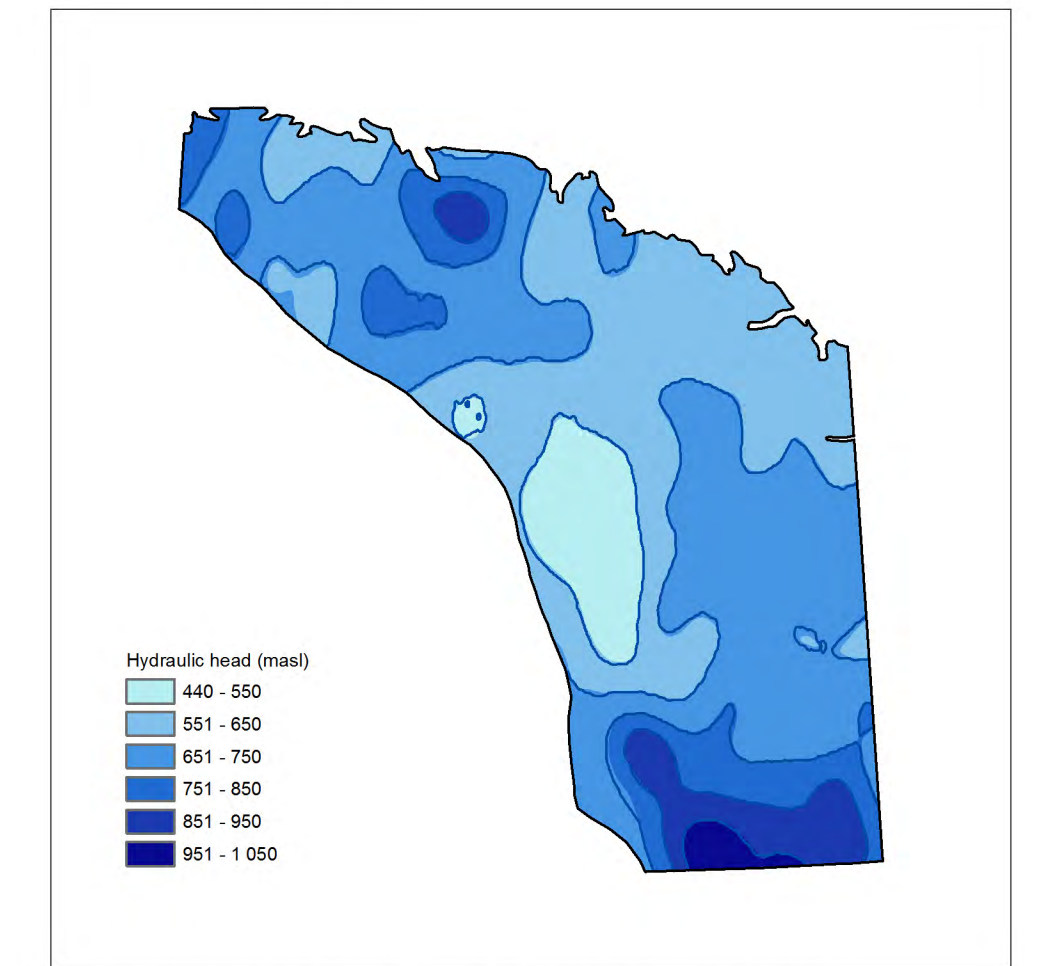


Figure 4. Distribution of hydraulic head in the Wapiti / Belly River HSU.

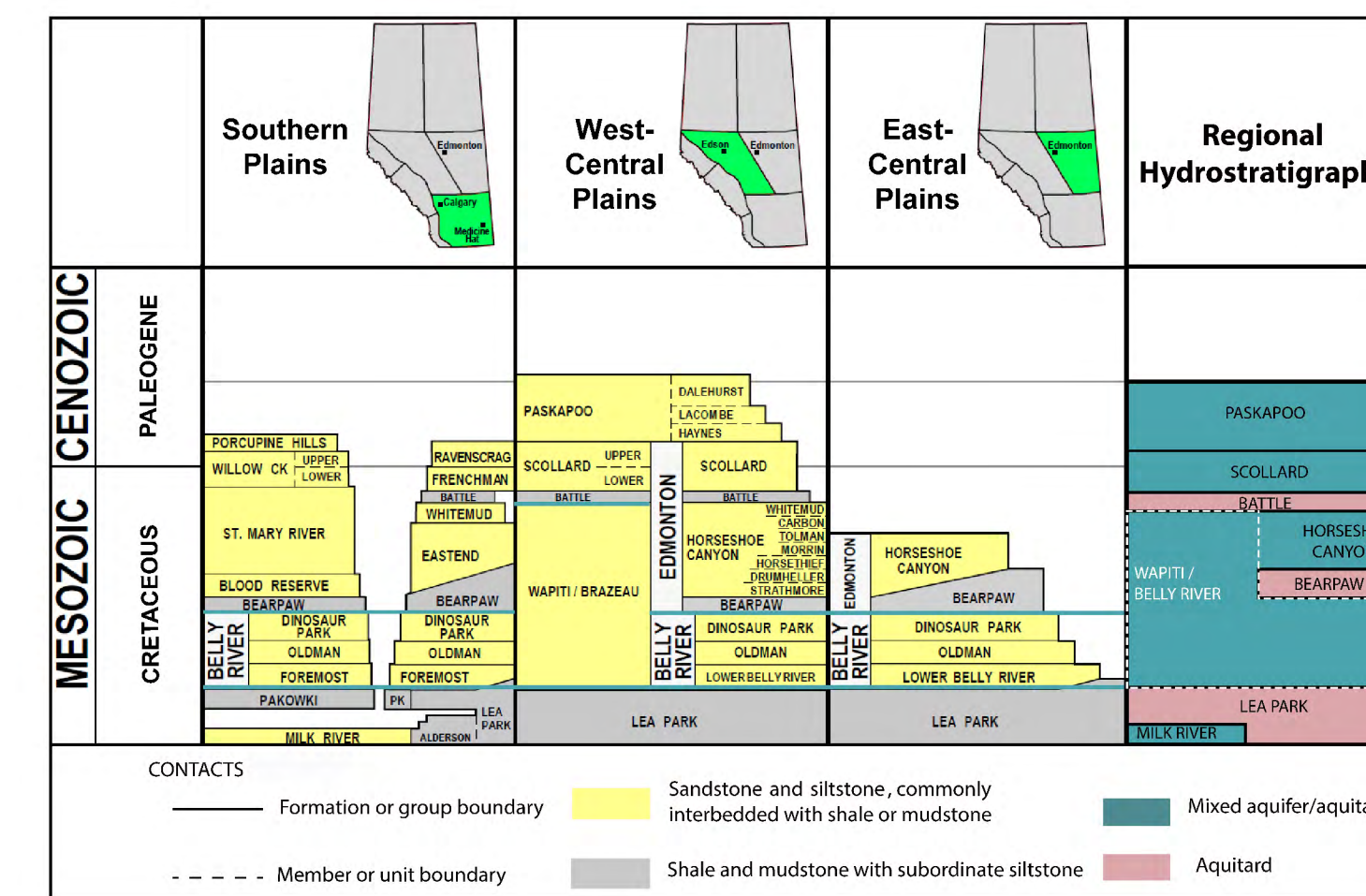


Figure 1. Alberta Table of Formations with regional hydrostratigraphy (modified after Alberta Geological Survey, 2015). Solid teal lines depict the top and base of stratigraphic units combined for the mapping of the Wapiti / Belly River HSU. Dashed white lines depict the Wapiti / Belly River HSU within the regional hydrostratigraphy.

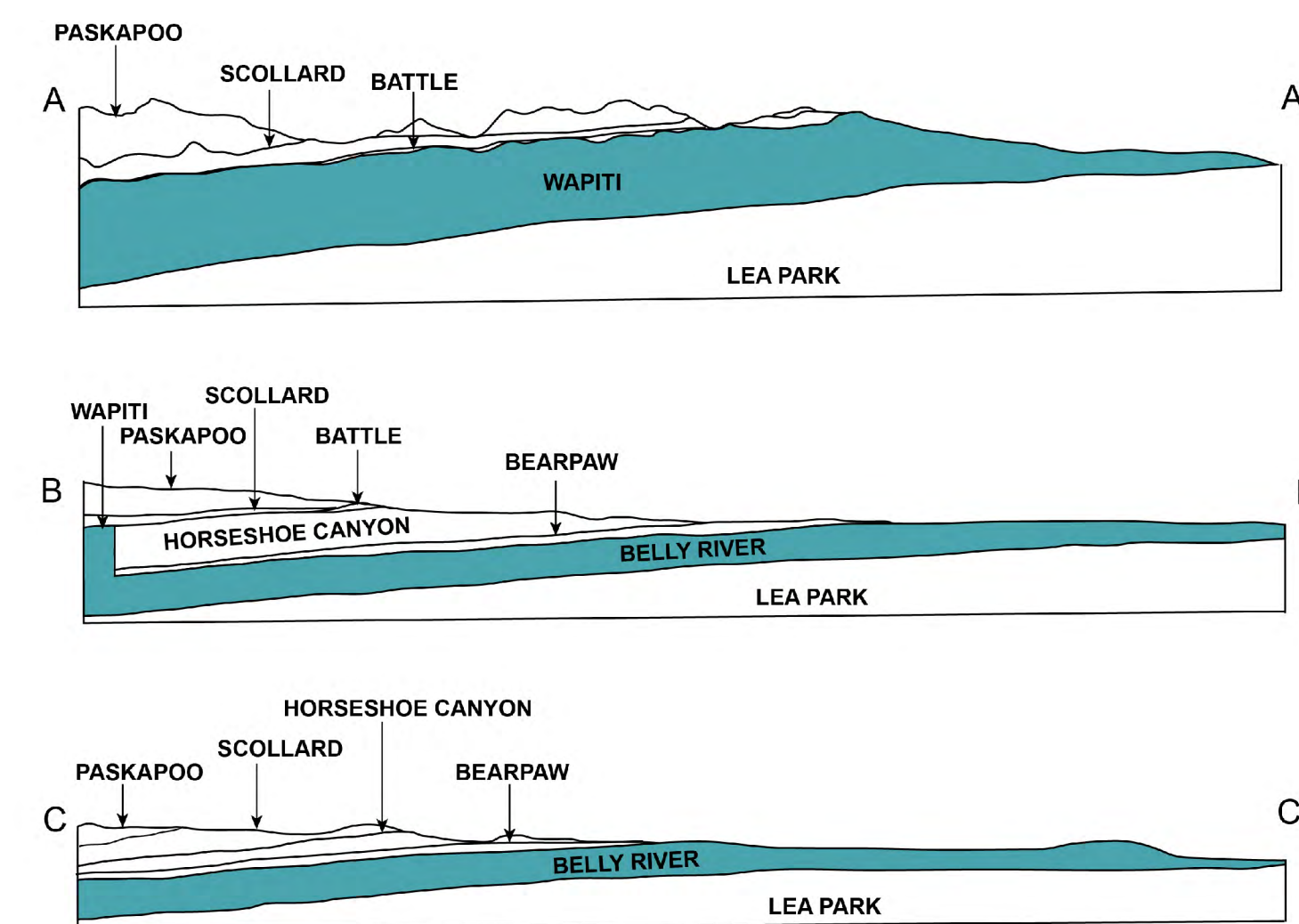


Figure 2. Schematic cross-sections identifying the geometry and variable thickness of the Wapiti / Belly River HSU (not to scale).

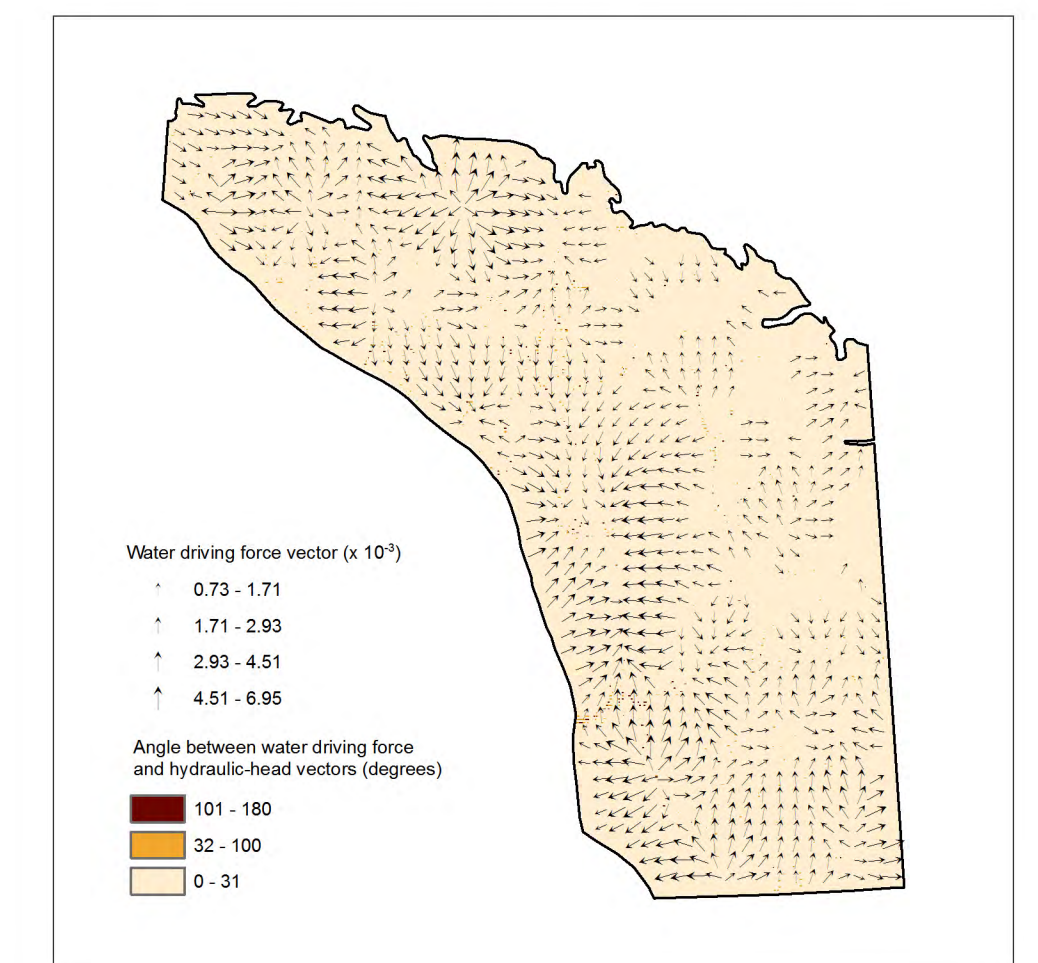


Figure 5. Water driving force analysis in the Wapiti / Belly River HSU indicating no significant density or buoyancy effects on the groundwater flow system due to low salinity (less than 20 000 mg/L) and dominance of the hydraulic-head gradient over the density gradient.

**Acknowledgements**

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**References**

Alberta Geological Survey (2015); Alberta Table of Formations; Alberta Energy Regulator, URL <http://ags.aer.ca/activities/table-of-formation.htm> [September 2015].

Bachu, S. and Underschultz, J.R. (1995). Large-scale underpressuring in the Mississippian-Cretaceous succession, southwestern Alberta Basin; AAPG Bulletin, v. 79, p. 989-1004.

Natural Resources Canada (2012); CanVec digital topographic data; Natural Resources Canada, Earth Sciences Sector, URL <http://ftp2.cits.mcan.gc.ca/pub/canvec/province\_fgdb/ab/canvec10\_gdb\_AB\_HD.zip> [December 2012].

Singh, A. and Nakevska, N. (2019); Distribution of hydraulic head in the Wapiti / Belly River hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 543, scale 1:1 750 000.

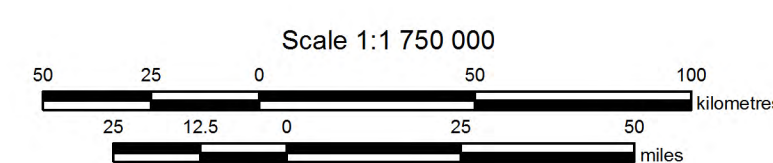
Singh, A., Palombi, D., Nakevska, N., Jensen, G. and Rostron, B. (2017); An efficient approach for characterizing basin-scale hydrodynamics; Marine and Petroleum Geology, p. 332-340, URL <http://dx.doi.org/10.1016/j.marpetgeo.2017.02.015>.

**Recommended Reference Format**

Nakevska, N. and Singh, A. (2019); Distribution of total dissolved solids in the Wapiti / Belly River hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 542, scale 1:1 750 000.

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Projection: 10 Degree Transverse Mercator  
Datum: North American Datum, 1983

