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Mudstone Depressurisation Behaviour in an Open Pit Coal Mine, Indonesia

Geneviève Marchand, John Waterhouse, Joseph Crisostomo

Golder Associates

Tutupan, South Kalimantan, Indonesia

Geology

Depressurisation Mechanisms

- Reduction in pore pressure in slopes may occur as a results of three mechanisms (Read and Stacey, 2009):
  - Groundwater flow away from the zone in question;
  - Lithostatic unloading : Increase in total porosity, caused by deformation and expansion of the rock, as a result of stripping the overlying material; and
  - Hydrostatic unloading: Increase in total porosity caused by expansion of the rock mass as a result of drainage and removal of water from the overlying rock.

At Tutupan, the thinner mudstone units (less than 20 m) generally depressurise quickly with lithostatic and hydrostatic unloading (drainage of adjacent sandstone units)

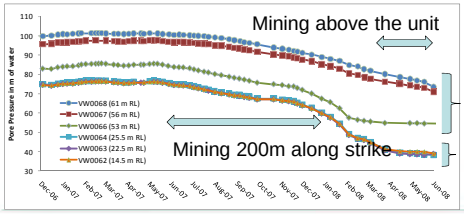
Methodology

- The mudstone pore pressure trends with time were interpreted by taking into account:
  - The position of the sensor within the unit
  - The thickness of the unit
  - The presence or absence of known thin sandstone units within the mudstone
  - Unloading by mining above and along strike
  - The position of the mudstone within the sedimentary sequence

Unloading of mudstone units through mining has an immediate effect on pore pressure close to the excavated face, regardless of the thickness and properties of the unit.

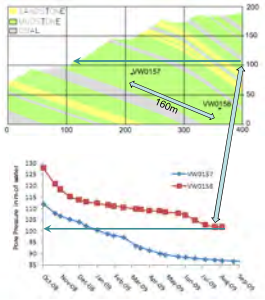
Results – Mining Along Strike

- 3 VW sensors above a coal seam (VW0066, VW0067 and VW0068)
- 3 VW sensors below the same coal seam (VW0062, and VW0064)



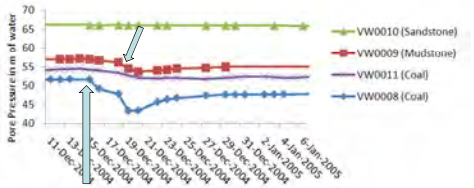
Results – Lithostatic Unloading Depressurisation with Depth

- Two sensors in the same unit at different depth
- End of Mining October 2008
- VW0158
  - Deeper Sensor
  - Slower Response
  - Decrease to 100m which is equivalent to the elevation of the unit where it is exposed.

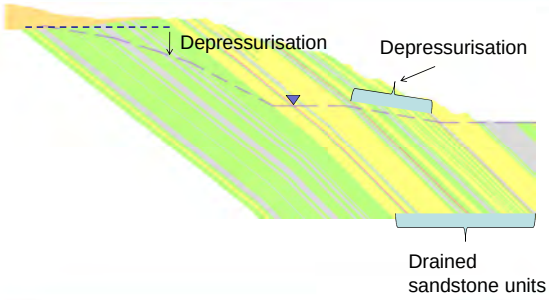


Results – Hydrostatic Unloading Drainage of Thin Adjacent Units

- Trial dewatering of a coal seam.
- Immediate response within adjacent mudstone units
- Decline in pore pressure too small to be used in slope design



Results – Hydrostatic Unloading Drainage of Thick Sandstone Units in Low Wall



Conclusions

- Mining along strike depressurises the mudstone up to 200m along strike.
- The mudstone units higher in the sequence show lower strengths and permeability and are less responsive than the deeper mudstones.
- Lithostatic unloading induces depressurisation at depth.
- Hydrostatic unloading of adjacent units reduces the pore pressure in thick mudstones:
  - Drainage of thin interbeds of coal and sandstone has minor effect on pore pressure.
  - Intensive dewatering of thick sandstone units reduces pore pressure in the portion of the mudstone adjacent to the dewatered sandstone.
- The rate of depressurisation is rarely sufficient to be used in slope design.

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