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Quantification of water and sediment yield from small catchment in open mining areas: experience and results from Poro nickel mining basin in New Caledonia

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Water management in mining environments is a major challenge of the mining projects. In New Caledonia large areas have been excavated for Nickel mining since the end of the 19th century. In the past, the bad management of the water and coarse sediments left scars in the landscape and management problems in the channel reaches downstream. Nowadays, open mining techniques no longer yield coarse material out of the mining areas but the management of water and fine sediment remains a difficult question as the suspended sediments reach the very fragile environment of the lagoon. In addition, in many areas, it threatens human activities in the downstream rivers. In order to quantify and understand the formation of runoff, erosion and sediment transport in small mining watersheds the "Hydromine" project was initiated in 2008 by the New Caledonia government (DAVAR) with the collaboration of the University of New Caledonia (UNC) and later with the scientific support of Irstea Grenoble. The questions addressed by this project are:
- What is the response (water and sediments) of a mining watershed to a rainfall input?
- What factors control this response?
- What are the processes involved? And which are dominant in the various hydrometeorological situations?
- What are the characteristics of the transported materials?
- What is the efficiency of mitigation works in the mining area?

Two small embedded catchments (0.09 and 0.30 km^2) are monitored for measuring rainfall, runoff and fine sediment transport in the mining area of Poro, East cost of New Caledonia. Elevation ranges from 197 to 366 m.a.s.l. The slope are steep (36 % in average but locally up to 130%) and the vegetation cover is very low (20% for the larger basin, 0% for the headwater basin). Rainfall-runoff and discharge-sediment concentration (SSC) relationship were analysed at the event and annual time scale. As a result, we pointed out the main factors that influence the response of the basins to a rainfall event: rainfall depth, rainfall intensity in fifteen minutes and in two hours, peak discharge, runoff coefficient, dry time duration before the event and flood duration. The calculation of suspended sediment yield (SSY) at different time scales gives an evaluation of the pollution delivered to the creeks and lagoon and of the water management and sediment trap efficiency. An extreme rainfall event (December 25th, 2011) of 500 mm in 26 hours yielded downstream more suspended sediment than all the floods of the previous monitored period. This highlights the threshold effects in runoff and erosion response in these open mining areas.