Integrate Evaluating Program on Drilling Discharge Effects in a Northern Adriatic Sea Site

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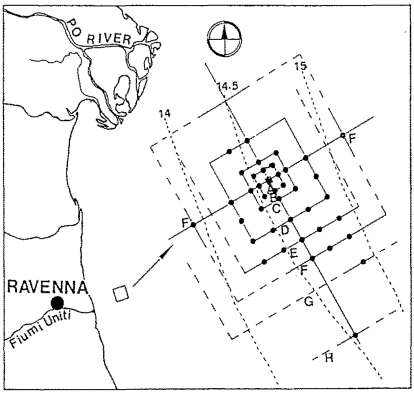
The effects of water-based drilling muds and cuttings were evaluated at a gas drilling field located offshore Ravenna (Italy) in the Northern Adriatic Sea on 15 m deep bottoms. Nine wells were drilled in a 3000 m deep Plio-quaternary sequence of muds, silts and marly clays. The discharge consisted of 4000 tons of cuttings and 2000 tons of drilling muds composed mainly of bentonites and baritine added with chromium lignosulphonates, lignites and sodium hydrate.

The study was promoted by AGIP (AA.VV.,1989) and performed over four sampling occasions including a preoperative survey (June 1985), two operative surveys (February 1986 - September 1986) and a postoperative survey (June 1987). Sampling was carried out along a grid elongated in the direction of the prevailing autumn - winter water currents (NNW-SSE) (Fig.). In the grid, collecting stations were located closer to each other near the platform.



At the preoperative survey, the drilling area was found to receive silty clayey sediments from the Po and some smaller rivers. Natural levels of some heavy metals (mainly Fe, Cr, Pb, Mn, Cu, Zn) and their surface increase derived from urban and industrial wastes were evaluated. The chemical effects of drilling mud discharge were estimated, by comparison, in following surveys. Biological effects were evaluated by means of taxonomic and structural analysis of macrozoobenthic communities and heavy metal incorporation in a target species. The bivalve Corbula gibba was chosen as the target species due to its abundance throughout the whole study area.

The results evidenced the following effects:

1. Physical: due to the platform. This structure interacts with the waves and water currents causing turbulence, erosion and re-suspension of bottom material, with grain size sorting. Under conditions of high hydrodynamic energy, a selective deposition of particles discharged by cuttings along the direction of the main water currents takes place.

2. Physical: due to the discharge material. Due to the discharge of heterogeneous material a deposition of different grain size particles occurs around the platform, which will be re-elaborated by later dynamic events

3. Chemical: due to discharge of drilling fluids These include: mean increases of an order of magnitude for Ba, about 38% for Cr, 85% for Pb and decreases of 52% for Cu. These elements, originally associated to the cuttings and drilling muds, at discharge are bound to particles having well defined size and depositional patterns. Thus, their migration is strongly influenced by the hydrodynamic situation both at discharge and afterwards.

4. Biological: on the macrozoobenthic community. A generalized reduction in species richness, diversity and abundance was observed. Complete defaunation was found at some stations located near the platform. Opportunism of particular species which is typical in chemically polluted bottoms did not occur. Some areas showed settling by mixticolae species in relation to grain size variation of the sediment. Generally, the observed variation of benthic communities can be ascribed mainly to a physical impact, in terms of burying, grain size variation and changes at the sediment-water interface.

5. Biological: heavy metal incorporation by the target species. The values of Cu, Zn, Mn and Cr in Corbula gibba, elaborated to exclude the effects of biological variables, were increased in the post-operative period. Over the sampling area grid, the values were homogeneous only in the first operative period. In the following periods, a significant correlation with distance from the platform was found for Cr and Zn, especially along the direction of the prevailing water current.

The spatial extent of environmental impact includes a smaller area closer to the drilling site where effects were recorded in all the above mentioned aspects. Detectable modifications of the benthic communities are limited to this area. Its extension corresponds well with the areas of deposition of the heavy and coarse materials. Outside this area, and mainly along the SSE direction, a second zone of environmental impact can be evidenced only by the chemical modification of sediments and by heavy metal incorporation in the target species. Maximum disturbances were detected during the second operative survey. The postoperative survey shows a pattern of partial recovery .

REFERENCE

AA.VV. - 1989 - Studio delle alterazioni litologiche, geochimiche e biologiche dei fondali marini interessati dagli scarichi dei fluidi di perforazione della piattaforma Antares - Alto Adriatico. Frascari F. & Bonvicini Pagliai A.M.Eds ,

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