Institution: Aberystwyth University

Unit of Assessment: 17: Geography, Environmental Studies and Archaeology

Title of case study: Eradication of child and adult mortality from lead poisoning following community resettlement: Mitrovica, Kosovo

1. Summary of the impact

The results of commissioned research by Aberystwyth University (AU) have shaped decision-making that led to the relocation of refugee Roma, Ashkali and Egyptian (RAE) communities in Mitrovica, northern Kosovo. In 2009/2010 AU research unequivocally identified the source of elevated lead (Pb) levels in soils that had been blamed for high infant and adult mortality rates in RAE refugee camps, and established that Roma Mahalla had sufficiently low soil Pb levels to permit the construction of a purpose-built housing development for the RAE communities. Following the relocation of the RAE families to Roma Mahalla in 2010/2011 there has been a significant reduction in blood Pb levels in children with no reported deaths attributable to Pb poisoning. This AU research project has had a demonstrable positive impact on life quality and human health of the resettled RAE communities living in Mitrovica.

2. Underpinning research

For more than 20 years Macklin (MGM) and Brewer (PAB) have led UK geomorphological-geochemical research into the impacts of modern and historical metal mining on river systems worldwide. They have an internationally recognised track-record of research into the sources, transport pathways and sinks of sediment associated contaminant metals (especially lead [Pb], zinc [Zn], copper [Cu] and cadmium [Cd]) in the fluvial environment as well as their impacts on human and ecosystem health[3.1-3.3]. Since 1993 their research in these fields at AU (Brewer, 1993-, Macklin, 1999-) has led to the publication of 43 peer-reviewed articles, 23 commissioned scientific reports and the award of 18 research grants and consultancy projects worth £1.37 million.

Pioneering research by MGM identified that the dispersal, storage and remobilization of sediment-associated metals in the fluvial system can be directly related to sediment transport processes and flooding regimes. Furthermore, the realisation that more than 90% of metal contaminants in rivers are transported in a particulate-associated form and, therefore, follow the same transport pathways as the natural sediment load of a river, led to the development of the 'geomorphological–geochemical approach' for assessing the environmental impacts of metal mining in river basins[3.2]. This fundamental research has subsequently been applied to the identification and solving of environmental problems arising from the legacy of historical metal mining in the UK (funded by DEFRA[3.4], EPSRC[3.5] and the EA[3.6]), Europe (e.g. Bulgaria funded by the Royal Society) and South America (funded by NATO and National Geographic[3.7]).

In the last decade or so, development of geomorphological-geochemical research tools and the application of Pb-isotope analysis has enabled the specific impacts of mine tailings dam failures in South America[3.7], Spain (by MGM, PAB and their co-workers and funded by NERC and Boliden Apirsa) and Romania (funded by the Royal Society, Rosia Montana Gold Corporation, and Maramureş/Satu Mare County Councils) to be investigated and effectively managed. Sediment mixing models have been used to establish the geochemical/pollution 'footprint' of the Rosia Montana gold mine in Romania. The model outputs were incorporated within the mining company's application to exploit and develop Europe's largest gold reserve in the Apuseni Mountains.

As a result of their research on metal contamination following the 2000 Yorkshire Ouse floods, MGM and PAB were commissioned by DEFRA[3.4], EA[3.5] and Lloyd's of London[3.8] to produce a series of policy and emerging risks guidance reports to steer environmental assessment and regulation. It was as a direct consequence of this work that MGM and PAB were asked by the Foreign and Commonwealth Office in Kosovo to help resolve the problem of relocating the refugee RAE communities to an environmentally 'safe' site within Mitrovica, Kosovo.

From 2000, concerns had been raised about the health of RAE communities who were displaced during the 1999 Yugoslav conflict, and who were living in two refugee camps (Cesmin Lug and Osterode) on former industrial land around Mitrovica in northern Kosovo. These

communities were subject to abnormally high adult and infant mortality rates, prompting the WHO to recommend immediate closure of the refugee camps. In December 2009 PAB and MGM (under the aegis of Fluvio, the brand-name for applied research by the River Basin Dynamics and Hydrology Research Group at Aberystwyth University), were commissioned by the Foreign and Commonwealth Office in Kosovo[3.1], Post Telecommunications Kosovo (PTK) and NGOs (Norwegian Church Aid, Danish Refugee Council, Mercy Corps) to (i) establish if Roma Mahalla (a suburb of Mitrovica) was an environmentally 'safe' location to build a new housing development for the relocation of the displaced RAE communities, and (ii) identify the source(s) of soil Pb in the Mitrovica region and recommend appropriate remediation strategies. Although funding and planning permission were in place for the Roma Mahalla development, the principal barriers to initiating the scheme were concerns regarding possible soil contamination at the site and the lack of data confirming the Pb-source(s) responsible for the high mortality rates in the camps; the RAE communities were reluctant to move unless assurances could be given that Roma Mahalla would be a 'safe' place to live. Fluvio's commissioned research project was specifically designed to provide an independent and objective evidence base that would result in the removal of these barriers to the Roma Mahalla development.

The results of a detailed field-based sampling programme identified severe Pb contamination in the soils underlying the occupied Cesmin Lug and Osterode refugee camps. Pb concentrations in soils (5,100 mg kg^{-1}) and house dust (5,900 mg kg^{-1}) exceeded the UK CLEA Soil Guideline Value for residential use/allotments (450 mg kg^{-1}) by more than tenfold, rendering the camps wholly unsuitable for human habitation. However, the data also demonstrated that land quality at Roma Mahalla was significantly better, with mean Pb concentrations in surface soils (513 mg kg^{-1}) only marginally exceeding the 450 mg kg^{-1} threshold CLEA value.[3.9,3.10]

3. References to the research

3.1 Peer-reviewed paper: Macklin, M.G., Brewer, P.A., Balteanu, D., Coulthard, T.J., Driga, B., Howard, A.J. and Zaharia, S. (2003): The long term fate and environmental significance of contaminant metals released by the January and March 2000 mining tailings dam failures in Maramureş County, upper Tisa Basin, Romania. *Applied Geochemistry* 18, 241-257. http://dx.doi.org/10.1016/S0883-2927(02)00123-3.

3.2 Peer-reviewed paper: Macklin, M.G., Brewer, P.A., Hudson-Edwards, K.A., Bird, G., Coulthard, T.J., Dennis, I.A., Lechler, P.J., Miller, J.R., and Turner, J.N. (2006): A geomorphological approach to the management of rivers contaminated by metal mining. *Geomorphology* 79, 423-447. http://dx.doi.org/10.1016/j.geomorph.2006.06.024.

3.3 Peer-reviewed paper: Miller, J.R., Hudson-Edwards, K.A., Lechler, P.J., Preston, D. and Macklin, M.G. (2004): Heavy metal contamination of water, soil and produce within riverine communities of the Rio Pilcomayo basin, Bolivia. *Science of the Total Environment* 320, 189-209. http://dx.doi.org/10.1016/j.scitotenv.2003.08.011.

3.4 Research grant: Macklin, M.G., Brewer, P.A. and Coulthard, T.J. 'The use of geomorphological mapping and modelling for identifying land affected by heavy metal contamination on river floodplains'. DEFRA (SP 0525), £20,012. 01.03.2003 – 30.06.2003 Peer-reviewed commissioned report. Brewer, P.A., Dennis, I.A., Macklin, M.G. (2005): The use of geomorphological mapping and modelling for identifying land affected by metal contamination on river floodplains. DEFRA Research and Development Report SP 0525, 58 pp. http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=10969.

3.5 Peer-reviewed commissioned report: Hudson-Edwards, K.A., Macklin, M.G., Brewer, P.A. and Dennis, I.A. (2008): Assessment of Metal Mining-Contaminated River Systems in England and Wales. Commissioned by the Environment Agency (Science Report SC030136/SR4), 55 pp. http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/scho1108bozd-e-e.pdf.

3.6 Research grant: Macklin, M.G., Coulthard, T.J. and Brewer, P.A. 'Contaminated Sediments: Assessing Environmental and Public Health Risks'. EPSRC (GR/S76304/01), £154,388. 01.09.2004 – 31.08.2008.

3.7 Peer-reviewed paper: Hudson-Edwards, K.A., Macklin, M.G., Miller, J.R. and Lechler, P.J. (2001): Sources, distribution and storage of heavy metals in the Rio Pilcomayo Bolivia.

Journal of Geochemical Exploration 72, 229-250. http://dx.doi.org/10.1016/S0375-6742(01)00164-9.

3.8 Peer-reviewed commissioned report: Macklin, M.G. and Harrison, S. (2012): Geomorphology and Changing Flood Risk in the UK. *Lloyd's Emerging Risk Reports*, 25pp. http://www.lloyds.com/the-market/tools-and-resources/research/exposure-management/emerging-risks/emerging-risk-reports/climate/geomorphology-and-changing-flood-risk-in-the-uk

3.9 Commissioned research report: Brewer, P.A., Bird, G, Macklin, M.G. and Swain, C.H. (2010): Geochemical assessment of soils in Roma Mahalla, Mitrovica, Kosovo: implications for the proposed resettlement of families presently living in the Osterode and Cesmin Lug Camps. Commissioned by the Foreign and Commonwealth Office (Kosovo) and Post Telecommunications Kosovo. Fluvio report 2010/02/66, 44 pp.

3.10 Commissioned research report: Brewer, P.A., Bird, G, and Macklin, M.G. (2010): Pb levels and Pb isotopic signatures determined in samples of scalp hair from residents of the Osterode and Cesmin Lug camps, Mitrovica, Kosovo. Commissioned by the Foreign and Commonwealth Office (Kosovo) and Post Telecommunications Kosovo. Fluvio report 2010/03/67, 10 pp.

4. Details of the impact

The research undertaken by MGM and PAB in Kosovo provided the evidence base for the relocation of residents of the Osterode and Cesmin Lug refugee camps to a new site at Roma Mahalla, and as a result, to sharp reductions in blood lead levels and consequently to the eradication of child and adult mortality from lead poisoning among the RAE refugee community. Recommendations from the commissioned research reports were presented at meetings in Mitrovica (March 2010) attended by the British Ambassador to Kosovo, the Mayor of Mitrovica, the Kosovan Minister for Communities and Returns, the Chief Executive Officer of PTK, various NGOs, the press and leaders from the Roma Mahalla, Osterode and Cesmin Lug refugee camps.

The reports/presentations triggered widespread media coverage in Kosovo (newspapers[5.1,5.2], television and radio interviews) and the research was also referred to in a question and answer exchange in the House of Lords between Lord Avebury and Baroness Kinnock[5.3]. The profile gained by such high-level political interest in the UK provided the momentum for the British Embassy in the UK to press for our recommendations to be implemented[5.4]: "*In response to Baroness Kinnock's letter …… the Kosovo Emergency Medical Group told UKAGW that they are pleased that the UK Embassy in Pristina has been working hard to try and get matters moving, and the recent Fluvio lead testing programme at the camps and Roma Mahalla is a testament both to their efforts, and that of the scientists involved".*

The published recommendations led directly to the following quantifiable actions and impacts:

1) In August 2010 construction began on the Roma Mahalla site and by September 2011 the first phase of the development was complete[5.5] - report recommendation 2. The two air photographs in Figure 1 show the Roma Mahalla site before (March 2005) and after (September 2011) housing construction.
2) By September 2010 the Pb-contaminated Cesmin Lug camp had been closed and this was followed by the closure of Osterode in December 2012 – report recommendation 1.
3) Improved knowledge and management of the risks posed by Pb in the Mitrovica region. In particular, Fluvio's research-informed recommendation was to deep-plough and resurface the site to reduce near-surface Pb levels. Mercy Corps, the NGO responsible for liaison with the RAE community, has confirmed that, "*your recommendation to deep plough the site was implemented before construction at a depth of 90 cm and gravel, from outside Mitrovica, was laid on top of the newly tilled soil for the 123 row houses that were constructed*"[5.6] - report recommendation 3.
4) Improved health and welfare outcomes, especially for children who are disproportionately susceptible to Pb poisoning. As reported by Mercy Corps: "*Shortly after their resettlement, more than 200 children, aged 0 to 6 years, had their blood lead levels tested at the local health clinic working with Mercy Corps. The results indicated that 82 percent of these children had elevated blood lead levels above 10 micro-grammes* per decilitre. *Such elevated blood lead levels impair neuropsychological functions and in particular, those of young children whose brains are developing. Treatments are available for the highest lead*

levels and diet and hygiene play a role in mitigating contamination. However, moving to the lead safe area of Roma Mahalla was the most important factor in reducing their blood lead level. Children resettled for 18 months or more had a median drop in blood lead levels of 36 percent."[5.6]

5) Following the demonstrable impact of the Roma Mahalla study, Brewer and Macklin were invited back to Kosovo by Mercy Corps to undertake a second land contamination assessment. The aim of this follow-up project was to identify an environmentally safe site for the relocation of some RAE families who, for ethnic reasons, could not move to the Roma Mahalla site[3.9].

MGM's and PAB's research was responsible for resolving in Mitrovica, Kosovo, what has been described by Dorit Nitzan, head of the World Health Organisation office in Belgrade, as "the worst ever Pb poisoning that we know of in Europe"[5.7]. Their scientific assessments and health guidance resulted in the lives of more than 160 families, including over 400 children and adults, being saved and protected, and it represents a benchmark study in the field of environmental toxicology.

Figure 1: Air photographs of the Roma Mahalla site prior to development (left image - snow-covered in March 2005), and post development (right image - September 2011). The red box demarcates the development site boundary. Images courtesy of Google Earth.

5. Sources to corroborate the impact

5.1 Marzouk, L. (2010): Experts call for pollution probe in North Kosovo. Pristina Insight, March 27 – April 8, p. 6.

5.2 Experts Call for Pollution Probe in North Kosovo. Balkan Insight March 15 (2010). http://www.balkaninsight.com/en/article/experts-call-for-pollution-probe-in-north-kosovo.

5.3 Citation in Hansard record of House of Lords (04/03/2010): question asked by Lord Avebury [HL2372] with response from Baroness Kinnock (http://www.publications.parliament.uk/pa/ld200910/ldhansrd/text/100304w0004.htm).

5.4 Direct quotation from Roma Files: (http://groups.google.com/group/Roma_Files/browse_thread/thread/87ecbeeed5addf6f/22c7153272009b59?lnk=raot).

5.5 EU starts building 38 houses in Roma Mahalla for Roma, Ashkali and Egyptian families living in Cesmin Lug and Osterode camps. European Commission Liaison Office to Kosovo press release. http://www.mercycorps.org.uk/articles/kosovo/new-homes-after-more-decade-displacement.

5.6 Letter from Mercy Corps, the main NGO charged with RAE liaison and humanitarian assistance.

5.7 BBC News (2009) Kosovo's poisoned generation, BBC News website, 14 January 2009, http://news.bbc.co.uk/1/hi/7827031.stm