Research Assessment Exercise 2020
Impact Case Study

University: Hong Kong Baptist University
Unit of Assessment (UoA): 26 Geography

Title of case study: Driving Geo-education and the Development of Geoparks in Hong Kong and Kenya

(1) Summary of the impact

Our research on Hong Kong landscapes was translated into formats that raised public and government geoconservation awareness. These efforts led to the first ever local geological guidebooks and changed public and government attitudes, contributing to policy changes that led to the establishment of the Hong Kong Geopark. Research in the Kenya Rift produced detailed geological histories and new knowledge on environmental processes. The results were presented to government officials, which led to changed mind-sets concerning geoconservation and provided the knowledge needed: 1) to delineate a new geopark, 2) to identify geopark field locations, 3) to cultivate geotourism, and 4) the capacity to develop a UNESCO geopark submission.

(2) Underpinning research

The Geography impact strategy emphasises: 1) world-class research, 2) public outreach, 3) interactions with government and society. Our research team for this study involves Earth Science colleagues (Prof. Owen, Drs. Muiruri, Chiu, Chow and Li, plus students Ray Lee and Polly Chan) and Prof. Li Si Ming, a human geographer, was a member of Agriculture, Fisheries and Conservation Department (AFCD) committees responsible for setting-up the Hong Kong UNESCO Global Geopark (HKGG).

Research that underpins our Hong Kong impacts include: 1) the production of new geology maps for specific geopark locations, 2) reconstruction of Hong Kong's geological and environmental history, spanning the last 400 million years, 3) studies of weathering processes and the variability in weathered materials across the territory, 4) research on marine cores that show how pollution, sedimentation rates and organic materials have changed with time, which provides information on how forest cover and erosion on land have changed, 5) studies of the impacts of ecotourism on the HKGG, and 6) work on human impacts on landscapes more widely across Hong Kong. Specific examples of research that led to impacts include studies of marine sediments that revealed pollution issues (Ref. 1), research on organic matter that established new information on Hong Kong's environment (Ref. 2) and changes in landscapes in and adjacent to the HKGG. Other research has been published, for example, in Nature Communications, Chemosphere, J. Hazardous Materials, Continental Shelf Research and Marine Geology. The research was translated into the first popular geological guidebooks in Hong Kong, which increased public awareness about our geological heritage and the need for geoconservation. Research papers and the popularity of the guidebooks constructively changed government official attitudes by showing what should be protected and that there was a popular demand to do so, eventually leading to the establishment of the HKGG.

Underpinning research in Kenya includes: 1) Sedimentological and microfossil-based reconstructions of environmental histories for all of the lake basins in the Kenya Rift, with evidence that covers the last 15 million years of environmental change, 2) new information on the geochemistry of sedimentary basins across the Kenya and East African rift valleys that demonstrate how the geochemistry of sediments is controlled by faulting and volcanism in addition to the more traditionally accepted climatic controls, 3) new models of rifting that incorporate tectonic, volcanic and climate controls, and 4) work on sediment and geochemical processes in modern lakes, such as mineral crystallisation dynamics, the impact of mantle CO_2 and hydrothermally-sourced SiO_2 on mineral precipitation, and the factors that determine tufa deposition. This work has been published in *Science*; *Proceedings of the National Academy of Sciences*; *Sedimentology*; *Sedimentary Geology*;

Palaeogeography, Palaeoclimatology, Palaeoecology; *Earth Science Reviews and Quaternary Research*. Examples of African research by Owen, Muiruri and Lee include studies at Olorgesailie in "Science" (Ref. 3) and work at Magadi in "Proceedings National Academy Sciences" (Ref. 4). Both document one-million-year climate histories. A 15-million-year record of environmental change has been developed for the Baringo Basin, which encompasses Quaternary lake and hot spring sediments (Ref. 5) and the geochemistry of a variety of East African rift basins (Ref. 6). These studies provided the capacity to delineate locations of conservation importance, new opportunities to advance geotourism and to raise public awareness. The research documented the significant geological heritage of the Kenya Rift, influencing government policy concerning geotourism and opportunity to propose a new UNESCO-recognised geopark—the first south of the Sahara.

(3) References to the research

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2. Owen, R.B., Lee, R., 2004. Human impacts on organic matter sedimentation in a proximal shelf setting, Hong Kong. *Continental Shelf Research* 24:583-602. https://www.sciencedirect.com/science/article/pii/S0278434303002437. *Examines variability in organic matter in HK sediments and reflects environmental change.*
3. Potts, R., Behrensmeyer, A.K., Faith, J.T., Tryon, C.A., Brooks, A.S., Yellen, J.E., Deino, A.L., Kinyanjui, R., Clark, J.B., Haradon, C., Levin, N.E., Meijer, H.J.M., Veatch, E.G., Owen, R.B., Renaut, R.W., 2018. Environmental dynamics during the onset of the Middle Stone Age in eastern Africa. *Science* 24, eaao2200–9. http://science.sciencemag.org/content/360/6384/86. *Environmental background to hominin evolution in the Kenya Rift. 54 newspaper reports in first year with 21,268 abstract reads and 2,198 pdf downloads in first 6 months*.
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5. Owen, R.B., Renaut, R.W., Hover, V.C., Ashley, G.M., Muasya, A.M. 2004. Swamps, Springs and diatoms: wetlands of the semi-arid Bogoria-Baringo Rift, Kenya. *Hydrobiologia* 518:59-78. https://link.springer.com/article/10.1023/B:HYDR.0000025057.62967.2c. *Examines origins and characteristics of wetlands in the Lake Bogoria National Reserve, Kenya.*
6. Owen, R.B., Renaut, R.W., Lowenstein, T.K., 2018. Spatial and temporal geochemical variability in lacustrine sedimentation in the East African Rift System: evidence from the Kenya Rift and regional analyses. *Sedimentology* 65:1697–1730. https://doi.org/10.1111/sed.12443. *Geochemistry of lake sediments in East Africa - new model of tectonic and volcanic controls.*

12 grants since 2000 (HK$5,766,793) - General Research Funds of RGC, except where stated:
2000: Owen - $317,817. Late Quaternary and modern organic matter accumulation in Hong Kong.
2006: Owen - $475,640. Paleoenvironmental interpretation of the Olorgesailie Formation, Kenya.
2009: Owen - $516,000. Middle to Late Pleistocene diatoms, palaeolakes and wetlands south Gregory Rift, Kenya.
2013: Owen - $974,123. Later Quaternary Diatom Stratigraphy of the Koora Graben and Lake Magadi.
2016: Chow KL- $496,690. Selection of wetland Plants for Wastewater Treatment in Hong Kong Wetlands. Environment and Conservation Fund.
2017: Li JF - $314,900. Compound floods from upstream river discharge, localized rainstorm and storm surge across the Pearl River Delta megacity region: Risks, Changes and Mechanisms.
2018: Owen - $336,865 Variability, characteristics and origins of hydrothermal-related silica in the Kenya Rift.

(4) Details of the impact

Impacts in Hong Kong: Research translated into popular media 1) increased public geo-conservation awareness, 2) changed attitudes of government officials and stimulated new policies that led to the establishment of the Hong Kong Global Geopark (HKGG), which attracts 1.4–1.5 million people annually, 3) had a positive effect on geotourism development with economic benefits for local communities, and 4) helped incentivise healthy outdoor activities for many individuals.

Increased public geoconservation awareness in Hong Kong: Awareness was raised following research that was translated into geo-educational formats. Initially, this involved radio programmes (three "Hong Kong Heritage"; one "Hong Kong Today"). By 2002, the first popular geo-guidebook (Hong Kong Landscapes: Along the Maclehose Trail) was published by the Geotrails Society (5000 printed; 500 remaining). Christine Loh, then of Civic Exchange, and later an HKSAR environment minister, wrote that "Should you wish to have a companion to take on a hike, there is no better book than this one". Linkages with NGOs such as Civic Exchange led to geological trail maps: "Wah Fu and Wah Kwai, Hong Kong's Portal to Nature" and "The South West Shoreline Trail" (2000 each) with TV documentaries following: 1) "Blueprint", RTHK (2005), 2) "Features of the Week", Cable TV[1] (2011) and 3) "Hiking-Walking", Now TV (2013), which attracted 1,236 Youtube followers.

Changed attitudes of HK government and geotourism: New opportunities were provided when three geo-educational books were published[2,3]. The first (Hong Kong Landscapes, 2007) was requested by Hong Kong University Press. David Wilson, a former Hong Kong Governor, wrote: "Dealing with the impact of both geology and human activity, this book will make a real contribution to showing what makes Hong Kong such a remarkable place". The book's success led to closer interaction with government officials. The AFCD requested: 1) 20 HKGG geology posters for the Lions Nature Education Centre, Saikung, and 2) two HKGG guidebooks[3] (~3000 copies each sold out). The "All in One" book was promoted at an AFCD press ceremony and was evaluated as "useful to excellent" by 252 *Ming Pao* readers. Both books had a positive effect on geopark development and geotourism, as documented by several societies in Hong Kong[4]. Public geoconservation awareness was further raised when Owen was interviewed about his geo-activities for the HKGG website and by popular newspapers/magazines, such as the *Hong Kong Economic Journal*[5], which attracted 260,256 Facebook and Twitter comments. Community understanding of geoconservation was advanced by Chiu through three geo-education articles for *Hong Kong Scouting Magazine* (circulation: 5000/issue), geopark seminars, and field trips for the continuing professional development of secondary Geography teachers, commissioned by the Hong Kong Education Bureau.

Geotourism and healthy outdoor activities: Positive effects on community behaviour have followed from field trips with our team having led twenty fieldtrips (~1200 people) since 2010 to the HKGG (HK Geographical Association, HK Geological Society, Natural History Society, Royal Geographical Society[6], Royal Asiatic Society). They had further positive effects by training 100 Geopark guides for AFCD, Tai Po Environmental Association and HK Discovery. In 2018, committee work by Chow had positive policy impacts on Country Park development.

Impacts in Kenya: Research and close contacts with government officials 1) changed attitudes to geological resources and stimulated the Kenya government to apply for UNESCO Global Geopark status, 2) provided the scientific basis that allowed recognition of geosites that should form part of a Rift Valley geopark, and 3) encouraged geotourism with Kenya geo-guidebooks in preparation.

Positive effects on government official attitudes and driving Kenya Geopark development: Owen had a positive influence on conservation planning by providing geology papers to the Lake Bogoria Reserve library. Copies of his Hong Kong MacLehose Trail and HKGG books were donated to the Lake Bogoria warden who commented: "when I first saw this work it led me to think there should be a similar trail across the North Kenya Rift", which has since been initiated. These contacts led to the setting up of a Kenya Rift eco-tourism centre at Mogotio, with Owen invited to "break-

ground" for an ecotourism building in 2014. Owen has promoted filming for a cross-rift trail[7] through the Kenya Geopark. In recognition of his research, Owen was invited to join the "Kenya Government Geoparks Advisory Board"[8], which promotes the Kenya Geopark and provides scientific advice on geological research through invited membership of the "Great Rift Centre for Research and Development (GRICERD) NGO".

Positive effects on geotourism: Our research has raised community geological awareness in Kenya and internationally. Early work at Olorgesailie, for example, was incorporated into a site museum display. Research on hominin-climate linkages have been reported in eighty international newspaper/magazine outlets[9]. Awareness of Kenya's geological heritage has been raised among stakeholders, who receive benefits from geotourism. This was achieved through discussions with government officials, chiefs and community leaders, and through media promotions, including for example, an NSF-funded video on human evolution and climate change in the Kenya rift[10], which was shown at the National Museum of Kenya, the national Museum of Ethiopia, and at international conferences. This video was adapted for an international audience in a PBS documentary (Climate of the Hominins), available through Amazon.com.

(5) Sources to corroborate the impact

(1) Example of Cable TV appearance on "Features of the Week", March 2011: [Link removed]

(2) Guidebooks: HKGG website noting: 1) Chapter (Geomorphology) in: Jim, (Ed) A New Geography of Hong Kong; 2) Geopark Field Guide 2 – Sai Kung; 3) Hong Kong Geopark All in One. Note other books are also on the link [Link removed].

(3) Guide book: English and Chinese guide to the Hong Kong Geopark commissioned by the Agriculture, Fisheries and Conservation Department, HKSAR: *Hong Kong Geopark All in One*.

(4) Support letters documenting the impact of geological outreach for Hong Kong geopark guidebooks: Letters recognising contributions to the HKGG and geo-education from the "Association for Geoconservation, Hong Kong", the "Geological Society of Hong Kong", the "Geological Society (Hong Kong Regional Group)" and "Hong Kong Outdoors".

(5) Published interview about geopark work: Focussed on Hong Kong Geopark on HKGG and Owen's Hong Kong and Kenya work in Hong Kong Economic Journal (in Chinese)

(6) Field trips for Hong Kong societies: Example of HKGG excursion for the Royal Geographical Society (Hong Kong) available on their web pages at [Link removed]

(7) Website documenting progress towards filming along the Trans-Rift Trail: Film in production. See web site details at: [Link removed] with children's book by Holly Renaut as an offshoot.

(8) Invitation letter to assist development of Kenya Rift Geopark: From Chief Warden/Geopark Development Coordinator for the North Rift Counties, Kenya

(9) Popular reports in international newspapers/magazines on Kenya Rift Research: Example of an international popular report on Kenya research by Owen in the East African Rift Valley by Elizabeth Pennisi in "Science" (Owen is second from right in photograph). See also PNAS and Science altimetrics to 79 newspaper articles through references 3 and 4 in Section 3.

(10) Popular film on Kenya Rift geology and human origins: Scientific evidence and script contributions to half-hour Public Broadcasting Service film "Climate of the Hominins", funded by National Science Foundation and shown on the PBS network in the USA. Available at Amazon.com. The latter is expanded from a 14-minute video "A human Climate" produced by through international collaboration (Hominin Sites and Paleolakes Drilling Project). Available at [Link removed].