



CURRICULUM VITAE

Robert Kirby, B.Sc., Ph.D., C.Geol., Dist.D.Ne of ASCE, FGS

PERSONAL DETAILS *Date of birth - 26.9.42. Nationality - British.*

ACADEMIC TRAINING University of Liverpool, B.Sc., [Ord.] 1964.
University of Liverpool, B.Sc., [Hons.] in Geology: Class 2:1 1965
[Special Honours course Sedimentology and Palaeontology].
University of London, King's College, Ph.D 1969.

EXPERIENCE The main progress has been in the discovery of oceanographic phenomena new to science and an increased understanding of the behaviour of sediments. These advances have been based on field experiments using new instruments and techniques developed by myself in conjunction with others. These new concepts have been successfully applied to various engineering problems.

In the port engineering field, Dr Kirby, accompanied by a small number of very expert colleagues, has developed and brought to commercial fruition two new Sediment Management Systems. He is the co-inventor of the **NAUTICAL DEPTH** concept, as well as the continuous vertical gamma-transmissance, and later, towed undulating (**NAVITRACKER**) profilers with which to measure this. Nautical depth is a concept applicable to fairway maintenance in high turbidity (fluid mud) systems. This initial concept must now be termed **PASSIVE NAUTICAL DEPTH**. It has been evaluated, ratified and promulgated world-wide by PIANC. Where applicable, for example, at Rotterdam/Europort (Holland), Zeebrugge (Belgium) and elsewhere it has resulted in major cost saving. In a new iteration, Dr Kirby has provided part of the science underpinning **ACTIVE NAUTICAL DEPTH**, a method to further minimise maintenance dredging need and at the same time use the fluid mud cloud to decontaminate the sediment in situ. The prototype port for this is Emden in Germany. Dr Kirby is also the co-developer of a revolutionary patented technique for reducing eddy-induced siltation in the entrance to blind-ending basins in lower turbidity regimes. These **ENTRANCE FLOW OPTIMISATION SYSTEMS (EFOS)** involve **SILLS** and **CURRENT DEFLECTING WALLS** and, from European Union-funded generic research contracts and practical experience in tidal situations, have been found to reduce sediment input from all three of the principal mechanisms. Creation of a design protocol for these systems has also required development of dedicated design technologies, which themselves have a wider application outside the immediate port engineering field. There is now years of practical experience with these systems at the prototype test site, Hamburg in Germany. Their use is now spreading in the port industry, with further systems envisaged for Hamburg as well as for Antwerp and potentially Rotterdam/Europort, three of the top ten ports in the world. They also contribute in a major way to an important change in modern port design, namely replacing impounded with tidal basins at high tidal range and turbid ports, a trend arising from competitive pressure from the container shipping trade. Benefits from these systems span a broad spectrum of economic and environmental issues and involve extremely large sums of money.

Dr Kirby is a shareholder and director in Balticon International, a company using new types of highly

mobile recycling plants to decontaminate waste terrestrial and marine mineral material. Following separation, a range of disposal options can be applied to the concentrated contaminants, whilst the primary minerals produced find a wide range of beneficial uses, for example in habitat creation or in manufactured products. This latter activity complements the two Sediment Management Systems.

In the coastal engineering field, Dr Kirby is the inventor of a patented self-sustaining soft sediment coast protection methodology, **TIDAL FLAT REGENERATION**, which involves placing wave attenuators and muddy dredge material to alter whole mudshore cross-sectional profiles from low and concave, to high and convex shapes. Similarly he is the co-developer of a “top down model” or mudcoast management system, **S-FACTOR ANALYSIS**, which permits shore stability and erosion-potential to be quantified for the first time. Dr Kirby has proposed the **MEHBY RULE** as a conceptual model for mudshores to stand alongside the accepted Bruun Rule for sandy shores. This encompasses and explains in summary form the contrasted behaviour of muddy and sandy foreshores.

Dr Kirby was Chairman of the PIANC MarCom Working Group 43 “**MINIMISING HARBOUR SILTATION**” (MHS) which sought to evaluate and promote generic Sediment Management Systems around the world. The report was published in October 2008.

He is a founding member of the SICEM, the **SEDIMENT INNOVATION CENTRE** in Emden, Germany, which aims to implement generic MHS technologies around the world with commercial links to Germany Belgium, France, Italy, Brazil, China and the USA.

Dr Kirby has written more than 60 reports and papers on the **SEVERN ESTUARY (UK)** and 15 papers on the **MEDWAY ESTUARY (UK)**, two eroding muddy coastal systems. He has been involved in every phase of **SEVERN TIDAL POWER BARRAGE** study of the modern era and supplied his scientific archive to facilitate progress with ongoing investigations.

1965-68 London University Ph.D. student - Cohesive sediment transport in Medway Estuary, Kent.

1968-70 Continental Shelf Unit, Institute of Geological Sciences, Edinburgh - marine geologist and chiefly responsible for unconsolidated sediments. Field work involved marine geophysical surveys using CSP equipment (pinger, boomer, sparker, magnetometer, gravimeter) and geological sampling surveys (of rock and unconsolidated sediment).

Early equipment was primitive and Dr Kirby was responsible for the design of a new gravity corer and the first British vibrocorer (manufactured under licence by Aimers McLean Ltd). He introduced the first small remote control rock drilling equipment and was responsible for establishment of the I.G.S. sedimentology laboratory.

1970-1984 Senior, later Principal Scientific Officer, Institute of Oceanographic Sciences, Taunton. Leader of joint Anglo-Dutch investigations of mobility of large sand waves in VLCC routes in Southern North Sea. Vibrocorer development continued and techniques devised for non-destructive quality control of undisturbed core samples.

Established "Cohesive Sediment Mobility Project" aimed at understanding the fundamental physics governing the behaviour (erosion, transport, deposition and consolidation) of cohesive sediment based on field experiment. Responsible for leading sedimentological investigations as part of Cohesives Project in Severn Estuary and Bristol Channel (UK) and in Europort (Netherlands). Responsible for design of experiments and data processing. The main scientific achievement has been the recognition of vertical and horizontal discontinuities in the suspended solids field. Dr Kirby proposed the term **LUTOCLINE** to describe the vertical discontinuities.

Further to identification of the lutocline phenomenon, together with a co-author he devised the first comprehensive mathematical quantification of the mechanisms of formation, stabilisation and dissipation of lutoclines. Lutocline physics is now a major topic of enquiry at many research institutes worldwide.

Requirements of high calibre experiments at sea led to the design of special items of equipment. These include:-

- Backscatter Density Probe [Built at AERE Harwell]
- Transmission Density Probe [Built under licence at AERE Harwell]
- Vertical Profiling Array [for silt, temperature and salinity]

This fundamental research has led to the introduction of new technology and advice to the dredging and

port industry as follows:-

- 1974 - 1984 Adviser to Netherlands Government, Associated British Ports at Hull, Immingham and Port Talbot, to BP and Forth Ports Authority at Grangemouth and to Port of London Authority at Tilbury on mud surveying and dredging problems, especially the use of in situ density measuring devices to monitor the channels as an alternative to conventional echo sounder surveys. The concept of a "Nautical Depth" was devised (density 1.2) being the density horizon within mud layers above which VLCC's can safely sail. The equipment and technique have been adopted worldwide.
- 1982 Expert witness advice in court case concerning dispute over effects of capital dredging scheme on surrounding oyster beds in Loch Ryan, Scotland.
- Other experience has been gained as follows:-
- 1979 - 1984 Project leader in investigation into mechanisms for incorporation of low level radioactive waste from Sellafield nuclear fuel reprocessing plant into Irish Sea sediments.
- 1976 - 1979 Member of 'Panel on Geophysics of Estuaries', Geophysics Study Committee, National Academy of Sciences, USA.
- 1973 - 1984 Sediment Science Ltd. Joint designer of Scour Inhibitor system and other devices to resist scour around civil engineering structures.
- 1980 Sediment Science Ltd., Expert witness advice in court case involving grounding of M.V. 'La Falda' in soft mud area at Barranquilla, Columbia.
- 1984 - Present Independent Consultant to Ravensrodd Consultants Ltd. in the fields of marine sedimentology, dredging, oceanography, sedimentation engineering, coastal engineering and environmental research.
- Designer of "Navitracker", the first practical towed gamma-transmission density profiling system to monitor the navigable depth in shipping channels 1984-1986. Commission from Baggerwerken De Cloedt SA., Brussels, Belgium.
- Sediments Adviser and contractor to all phases of Severn tidal power barrage studies in the modern era, including "Cardiff-Weston" and "English Stones" alignments. Input has ranged from barrage construction method, construction sequence and orientation to modification to sediment regime during and following construction as well as, finally, determining the environmental consequences. Ditto for La Rance barrage, Brittany. 2007 - present: Adviser and contractor to DECC Severn Tidal Power Project.
- Coastal Engineering consultant to Devon County Council in cases concerning alleged coast erosion arising from gravel removal from beach at Crow Point, Devon and alleged sand encroachment onto roadways from sand dunes at Instow, Devon.
- Designer of new methodology for predicting alterations to tidal flat elevation and shape caused by engineering works and sea level rise.
- Co-designer of patented passive Current Deflection Wall technique to reduce silt deposition in harbour basins. Device successful in Hamburg and elsewhere.
- Occasional visiting research fellow at Department of Civil & Coastal Engineering, University of Florida, Gainesville, USA. Consultant to South Florida Water Management District and St Johns River Water Management District, USA.
- Provider of CIWEM course on sediment transport, coastal zone management and coastal structures. School of Environmental Engineering, Department of Civil Engineering, Bristol University.
- Adviser and Expert witness to Department of the Environment (Northern Ireland) in court case concerning alleged smothering of oyster beds by sediment released from a defoliated salt marsh. Largest claim for civil damages in a Northern Ireland Court.
- Adviser to English Nature and to Institute for Terrestrial Ecology (NERC) on sediment related conservation issues.
- Adviser to Geotechnical Engineering Office, Government of Hong Kong on fine sediment problems arising from new airport at Chek Lap Kok, and other major projects. 600 million tonnes of mud to be dredged and disposed of and replaced by sea-dredged sand to provide the airport platform - then the world's largest marine civil engineering project.
- Consultant to Medway Ports Authority on long term evolution of the Medway, especially related to reclamation, spoil disposal and their relation to SSSI status.

Project Leader, LIP-2 & LIP-3 European Commission Research contract to study water and sediment exchanges at harbour mouths in the presence of a Current Deflecting Wall.

Inventor of Tidal Flat Regeneration concept. Full patent granted 1997.

Co-developer with Partech Instruments Ltd of infra-red profiling siltmeter array spanning the range 0-50,000mg/l. Ditto, later more sophisticated instrument with Delft Hydraulics.

Technical Adviser to North Devon, Somerset and South Avon Coastal Group. Author of report on long term evolution of this coast.

Contributor, as adviser and contractor, to “Long Term Vision for the Scheldt” project. Provision of Sediview and profiling siltmeter data for design of EFOS/CDW system at entrance to Deurganckdok tidal basin in Antwerp.

Board Member, Renewable Energy Foundation (REF) Tidal Power Forum.

Adviser to CEFAS on prospective new nuclear power stations at Hinkley Point.

Adviser to Bristol Port Company on Bristol Channel Deep Sea Container Terminal.

Director and Shareholder in Balticon International, a Danish company using mobile plants of varying capacity to recycle contaminated terrestrial and marine waste minerals into primary products. The purified minerals can be used in a wide range of applications and the separated pollutants incinerated or carried to a containment area.

Recipient of Lifetime Achievement Award as “Distinguished Diplomate in Navigation Engineering” (Dist. D. NE) of the Academy of Coastal, Ocean, Port & Navigation Engineers of the American Society of Civil Engineers (Washington DC) for innovation, starting 1965, in Sediment Management Systems for the international port and shipping industry.

Recipient of Thomas Telford “Telford Premier Award” of the Institution of Civil Engineers for Outstanding Paper of the Year in respect of Kirby & Retière (2009) Comparing ecosystem response of Rance & Cardiff-Weston tidal power barrages published in Maritime Engineering.

- COMMITTEES**
- 1981-1984: Dredging Working Group, British Ports Association, UK.
 - 1986-1989: Member of Sediment Working Party supervising and directing research on Severn Barrage Feasibility Project.
 - 1986-1989: Member of Intertidal Working Party supervising and directing research on Severn Barrage Feasibility Project.
 - 1988- : Invited contributor to European Estuary Study Group.
 - 1992-2010: Member of Ocean Resources Committee Society for Underwater Technology.
 - 1997-2000: Member WG106 of SCOR (Scientific Committee for Ocean Research) of UNESCO on Muddy Coasts.
 - 2003-2008: Chairman WG43 of PIANC “Minimising Harbour Siltation”.
 - 2007-2010: Member of International Expert Scientific Committee advising French government on project “Retablissement du caractere maritime du Mont-Saint-Michel” (Returning Mont-Saint-Michel to the sea) managed by Syndicat Mixte Baie du Mont-Saint-Michel.
 - 2007- : Founding member of SeBAS “Severn Barrage Association of Supporters”
 - 2009- : American Society of Civil Engineers –
 - i. Waterways Committee
 - ii. Nautical Depth Committee and Nautical Depth Sub-Committee

PUBLICATIONS Marine Geology and sedimentology, instrumentation, cohesive sediment behaviour, environmental impact, dredging, marine civil engineering, pollution, including radioactive waste disposal, coastal zone management, generic sediment management systems.

PROFESSIONAL Chartered Geologist

AFFILIATIONS Fellow of the Geological Society of London

PUBLICATIONS

- Prentice, J.E., Kirby, R, et al.,** 1968 Sediment Transport in Estuarine Areas. Nature Vol. 218, No.5148, p1207-1210.
- Kirby, R.,** 1969 Sedimentary environments, sedimentary processes and river history in the Lower Medway Estuary, Kent. Ph.D.thesis, London University, 2 vols. 491pp.
- Eden, R.A., Small, A.V.F. & McQuillin, R.,** 1970 Preliminary report on marine geological and geophysical work off the east coast of Scotland 1966-1968. Rep. No 70/1 Inst. Geol. Sci. (Section on unconsolidated sediments in Firth of Forth by R Kirby). 30p.
- Anon., Hydrographic Department,** 1971 Professional paper No.20 (H (MO) 744/68) 59pp.
- Kirby, R & Kelland, N.C.,** 1972 Adjacent Stable and Apparently Mobile Linear Sediment Ridges in the Southern North Sea. Nature (Physical Science) Vol 238, No.85, p111-112.
- Kirby, R.,** 1972 The UCS Vibrocoring, 1972 with evaluations of the Marex, Zenkovich, Geodoff and IGS Vibrocoring. Unit of Coastal Sedimentation No. UCS/10 1972. 32pp.
- Kirby, R & Parker, W.R.,** 1972 Preliminary report of analyses of fluid muds from the Bristol Channel and Severn Estuary. Unit of Coastal Sedimentation No UCS/3/1972. 6pp.
- Heath, G., Kirby, R., & Hamilton, D.,** 1972 The Severn Estuary and the Bristol Channel. An assessment of present knowledge. NERC Publication Series C, No.9, 19pp.
- Deegan, C.E., Kirby, R., et al.,** 1973 The superficial deposits of the Firth of Clyde and its sea lochs. Report No. 73/9 Inst. Geol. Sci. (including section on the distribution, mode of occurrence and composition of authigenic ferro-manganese oxides by R Kirby). 42pp.
- Kirby, R.,** 1973 The UCS Grain-size Comparator Disc. Marine Geology, 14, pM11-M14.
- Kirby, R & Parker, W.R.,** 1973 Fluid mud in the Severn Estuary and Bristol Channel and its relevance to Pollution Studies. Inst. Chem. Engrs., Graduates and Students Section Annual Symposium 'Estuarine and Coastal Pollution'. A4, 14pp.
- Kirby, R., Parker, W.R. & Hooper, D.J.,** 1973 The administration and technology of pollution investigations in UK estuaries. Report to Decca Survey Ltd. 130pp.
- Sediment Science,** 1974 Soil parameters and techniques for seabed engineering studies. Report to Decca Survey Ltd. 20pp.
- Kirby, R.,** 1974 The recognition of original and induced internal structures in samples taken with vibratory seabed corers. NEL/SUT Conference, East Kilbride. April, Paper 15, p1-16.
- Kirby, R. & Parker, W.R.,** 1974 Seabed density measurements related to echo sounder records. Dock and Harbour Authority Vol LIV, No. 641, p423-424.
- Parker, W.R. & Kirby, R.,** 1974. Studies of fluid mud in the Severn Estuary & Bristol Channel. Proceedings of the Challenger Society, 4, (6), p1-6.
- Kirby, R. & Oele, E.,** 1975. The geological history of the Sandtietie-Fairy Bank area Southern North Sea. Phil Trans R Soc., London. Series A, p255-265.
- Kirby, R.,** 1975. Report on port and harbour dredging and research in the United Kingdom. IOS Internal Report. 25pp.
- Kirby, R. & Parker, W.R.,** 1975. Sediment dynamics in the Severn Estuary: a background for studies of the effects of a Severn Barrage. In: Environmental effects of constructing a Severn Barrage, edited by T. Shaw, Bristol. University of Bristol Press, p35-46.

- Kirby, R.**, 1975. Fine sediment behaviour in the inner parts of estuaries. British Association for the Advancement of Science, Guildford 3/9/75. Published in Conference Proceedings. 8pp.
- Oele, E. & Kirby, R.**, 1975. Effects of the Pleistocene glaciation in the southern bight of the North Sea. Geological Society of London. Symposium on 'The Quarternary of the Continental Shelf around the British Isles' 22/10/75. Unpublished lecture, extended abstract published in Quarternary Newsletter. 2pp.
- Kirby, R.**, 1976. Practical applications of densimetry in dredging control. Discussion paper. First International Symposium on Dredging Technology, BHRA p19-21.
- Parker, W.R. & Kirby, R.**, 1976. Discussion of paper on Dredging in Alluvial Muds by L. Summers. Untitled paper on the use of echo sounders and densimeters for measuring seabed density. First International Symposium on Dredging Technology, BHRA p38-40.
- Parker, W.R. & Kirby, R.**, 1977. Fine sediment studies relevant to dredging practice and control. Second International Symposium on Dredging Technology. BHRA/Texas A and M Paper B2, p15-25.
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- Sediment Science**, 1978. Scour Inhibitor Field Trials at Instow 27-29/12/77, 4pp.
- Kirby, R.**, 1978. The work and some geological implications of research at the Institute of Oceanographic Sciences, Taunton. British Geologist, 5pp.
- Kirby, R., Parker, W.R. & van Oostrum, W.H.A.**, 1979. Definition of the seabed in navigation routes through mud areas. International Hydrographic Technical Conference, Ottawa. 12pp. Also by invitation: International Hydrographic Review. January, 1980. LVII (1), p107-117.
- Parker, W.R. & Kirby, R.**, 1979. Observations of fine sediment behaviour. First International Symposium on Cohesive Sediments. EBSA Churchill College, Cambridge, UK, 30/7/79, p1-10.
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- Kirby, R.,** 1985. Opinion concerning likely sedimentation issues with a tidal power barrage located at English Stones in the Severn Estuary. Ravensrodd Consultants. Report to Severn Tidal Power Group, 73pp.
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- Kirby, R.**, 1986. Suspended fine cohesive sediment in the Severn Estuary and Inner Bristol Channel, UK. Report to ETSU No ETSU-STP-4042. 243pp.
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- Kirby, R.**, 1989. The fine sediment regime of Lake Okeechobee, Florida and its possible significance in phosphorus budgets and cycling. University of Florida, project report to South Florida Water Management District, 20pp.
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- Kirby, R.**, 1989. A preliminary study of the possible environmental changes to West India Dock due to water and heat pumping. Report to Sulzer UK Ltd, 16pp.
- Kirby, R.**, 1989. Sedimentological perspectives on an English Stones Barrage. Report to MRM Partnership (Bristol), 6pp.
- Kirby, R.**, 1989. Tidal flat instability and fine-grained sediment transport at Ardmillan Bay, Strangford Lough, in relation to Spartina eradication and oyster trestle burial. Report to DOE (NI), 255pp.
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- Kirby, R.**, 1989. Evaluation of anomalously high summer turbidity values in the Elbe River close to Hamburg. Report to Hamburg Port Authority, 27pp.
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- Kirby, R.**, 1990. The sediment budget of the erosional intertidal zone of the Medway Estuary, Kent. Proc. Geol. Assoc., Vol 101, Part 1, p63-77.
- Kirby, R.**, 1990. Sedimentological consequences of the RSPB Living Waterfront scheme on Cardiff Bay and its approaches. Ravensrodd Consultants Ltd report to NCC, 10pp.
- Kirby, R.**, 1990. Supplementary Report: The sedimentary regime of Ardmillan Bay, Strangford Lough, Co. Down, Northern Ireland. Report to DOE (NI), 152pp.
- Kirby, R.**, 1990. Reclamation impacts on the sedimentary environment of the Medway Estuary and their relevance to birds: the example of Lappel Bank. Report to RSPB and NCC, 27pp.
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