

Baker + Stow

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8. Geoscience education for development – UK provision for overseas students

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Abstract: Overseas students follow in a long tradition of migrant study. Currently, the educational requirements of developing countries in the geosciences are, mainly, for the direct transfer of skills and expertise to meet immediate needs, coupled with the longer-term growth of geoscience centres in universities and surveys at home. The various degree, diploma and short courses on offer in the UK, together with the associated advantages of study overseas, go some way to meeting these requirements but fall short of what could be made available.

There are only about 200 overseas students taking geoscience courses in British universities and polytechnics at present, with Iraq, Egypt and Malaysia being the most usual countries of origin. The majority of students are funded by their own governments. They face problems of finding the right course and then getting the most out of it, as well as coping with the language and necessary social adjustments. More effective targeting of information on courses is desirable as well as more careful structuring of courses to meet overseas requirements.

A close partnership between a UK university department and a geoscience department in a developing country offers educational and research opportunities to both. At the same time, the development of international training centres, specifically designed for scientific and technical training and research collaboration with developing countries, is an option that the UK should explore for the future.

Introduction

Two intriguing advertisements recently appeared in *Nature* (30 June and 20 October 1988) relating to a conference on "Science, Technology and the Islamic Civilisation". The first posed questions such as "are there new scientific revolutions waiting to happen in the framework of Muslim culture and Islamic civilisation?" and "is ... modern experimental science value-free?". The second included the provocative statement that:

"A key assumption is that western civilisation's use of science and technology is injurious to the human personality and culture at all levels and also destructive of the physical environment".

Most of us would probably regard it as axiomatic that science itself is value-free and universal. But of necessity the support and priority given to science, and the way in which it is applied, will be dependent on a range of economic and culture-related variables. There may be legitimate reservations about educating students in an alien civilisation but these have little to do with the intrinsic nature of the science that is taught there.

There is nothing new about travelling abroad to established centres of learning. For example, in the early Islamic empire (9th-14th centuries AD), Baghdad with its "House of Wisdom" attracted

scholars from all over the known world. At that time, much of what is now referred to as "the West" could be regarded as undeveloped or "developing countries". From the time of the Renaissance onwards, science in western Europe progressed slowly and often painfully against established dogma and the Inquisition.

Education represents investment in the future. How one views "the future", as immediate or more distant, determines the emphasis placed on the more applied or pure aspects of science. Science as philosophy, a tradition dating from Aristotle, remained largely independent of technological developments until the early 17th century. The new approach was epitomised in 1620 by Francis Bacon in his *Novum Organum* where it was claimed that "the true and lawful end of the sciences is that human life be enriched by new discoveries and powers" (Fyrth and Goldsmith, 1973).

The growth of the geological sciences was intimately connected with the exploitation of natural resources and development of communications during the industrial revolution. Later, however, there was to be a measure of detachment between pure and applied aspects of science in higher education. This was partly due to the influence of John Henry Newman and his "Idea of a Liberal Education", published in 1850.

So far as the geological sciences are concerned it is only in relatively recent years that more

positive attitudes have emerged towards the teaching of applied geology within universities. In view of this, it is surprising that the recent UK University Grants Council "Review of the Earth Sciences" has resulted in the closure or amalgamation of several departments with strength in the applied aspects of geology. It is to be hoped that there will be renewed impetus for expansion in these areas since, in the present context, it is applied geology courses that tend to be of most interest to students from developing countries. In addition, of course, overseas students provide an increasingly important component of the income of British universities, and competition for students has intensified in recent years. This has brought with it increased sensitivity to the needs of overseas students and greater awareness of the demand for specific and relevant courses.

Geoscience Educational Requirements

The geoscience educational demands in relation to the developing countries fall into the following categories:

1. The direct transfer of skills and expertise in order to meet specific and immediate needs, e.g. in hydrogeology, engineering geology or exploration. So far as overseas education is concerned, this is best met by a specially designed taught course.
2. There is a still more important need for complementary growth of geological centres in universities, and geological survey departments within developing countries, to sustain and promote the skills that have been acquired abroad. Much of the essential field and practical training is best carried out, at least in part, in the country concerned.
3. There is a need for some students to acquire a broader education within the geosciences, to develop a wider appreciation of the potential of the earth sciences and acquire the intellectual discipline associated with training in science. Such people are likely to move eventually into education, government or management.
4. There is also a responsibility to ensure that exceptionally talented individuals have the opportunity of working in the very best laboratories. This requires a background and infrastructure that is affordable and available in very few places. Most countries have higher priorities that exclude the dedication of resources to expensive 'big science'. So long as opportunities exist and scholarships are available for this relatively small group, it need not be an aspect that concerns us further in the present context. Such travelling scholars will be following a tradition of migrant study that extends over many centuries.

Objectives of Degree Courses

The general aims of the degree courses on offer at higher education institutions in Britain may be summarised as follows:

BSc: This aims to provide the foundations of knowledge within a relatively broad subject area together with an awareness of its wider significance. It should also provide a training in basic techniques such as geological mapping and microscopy. It should ensure the acquisition of essential skills, and of literacy and numeracy. It should generate in the student a lasting enthusiasm and motivation for his/her chosen field of study.

MSc: This aims to provide enhanced knowledge in a more specific area with training in more advanced techniques. Project work usually involves a relatively well-defined problem. It provides practice in report writing and is generally viewed as a training for a career allied to a particular specialism.

PhD: This gives a student more advanced knowledge in a particular area of the subject and provides training in research. It also offers training in a range of techniques related to that area of the subject. The problem is more sustained and open-ended, with the student playing a role in identifying questions that need to be answered as well as in planning approaches to the problem. There should be practice in communication, including thesis and paper writing. It is not necessarily vocationally-orientated.

Apart from the specific objectives of the degree course, students may also expect to derive wider benefit from practice in speaking, reading and writing scientific and non-scientific English. They should gain insight into the ways of science and an understanding of the integrity of science and confidence should grow from their participation in scientific meetings. Working in an active geoscience department should in itself be an experience of some value later on, as students will understand the various roles of academic, technical and administrative staff. They will also gain experience of drafting and photographic techniques, and of sample preparation and curation, computing and data processing. If they are working on projects based in their home country they will at the same time be making a contribution to the geology of that country.

Many students will, however, be faced with a rather different situation when they return home. Support staff may be minimal and they may well have to do most things for themselves. There is thus much advantage to be derived from a very comprehensive background during their education overseas; but the equipment and analytical facilities available at home will often be very limited and training in the use of costly equipment may have been to little avail. In addition, libraries

may be poorly stocked and field work very difficult to support. Even so, students returning from abroad should have a good idea of what is needed and should know where to find the answer to questions that may arise. They should also have the advantage of being academically qualified to go abroad again for further periods of study and training.

Objectives of Short Courses and Diploma Courses

In addition to the undergraduate and postgraduate degree courses aimed at students, higher education institutions may offer other options, as follows:

Short Courses: these, 1-12 weeks duration, are available at many universities and institutions in Britain. For the most part, these aim to provide specialised in-service training for industry or for other professional groups. They have very specific and tangible goals: for example, they may provide an introduction to the methods and applications of remote sensing in geology, or giving an update on the latest concepts in petroleum sedimentology. Many are open to students as well as professionals.

Diplomas: these are generally awarded following a taught course of 6-12 months duration, at a standard somewhere between BSc and MSc degree level. Mostly the aims are to provide detailed knowledge and/or practical experience in a specific field of a more technical than academic nature. Within the geosciences, for example, there are several institutions in Britain that offer specialised training to geological technicians, for which the Higher National Diploma may be conferred.

A Recent Survey on Overseas Geoscience Students in the UK

From the result of a questionnaire circulated shortly before the 1988 Nottingham Conference, the following information was obtained. Regrettably, though, there was only about a 50% response, so the value of the survey is somewhat limited.

The following are the countries of origin of overseas geoscience students in the UK, given in order of frequency of citation in the responses:

- Iraq
- Egypt
- Malaysia
- Nigeria
- Pakistan
- Kenya
- China (including Hong Kong)
- Iran
- Libya
- Sudan
- Tanzania.

Many others were given but quoted less frequently. The main sources of funding, again in order of frequency, were home governments, British Council, industrial, private and finally UNESCO/University scholarships.

The following MSc courses were specifically cited as being appropriate for and taken by overseas students:

- Palynology
- Micropalaeontology
- Hydrogeology
- Mineral Exploration and Mining Geology
- Petroleum Exploration Geology
- Organic Petrology and Geochemistry
- Geology and the Extractive Industries
- Engineering Geology
- Geophysics
- Geological Exploration Methods
- Industrial Mineralogy.

The average numbers of overseas students on particular degree courses in the departments responding were as follows:

BSc	1.8
MSc	1.4
PhD	2.3
Diploma	1.2.

This gives each department an average of 6.7 overseas students on geoscience courses and probably means there is a total of about 200 in all UK universities.

The results of this survey (summer 1988) date from just before the major reorganisation of earth science departments in UK universities; the lack of response from some departments, however, may have been due to the knowledge of these impending changes. By the end of 1990 there will have been a 30% reduction in the number of full-size university geology departments in Britain and, as a consequence, the loss to overseas students of some specially tailored MSc courses (e.g. Geological Exploration Methods at Nottingham). However, the loss in potential places for the overseas student may only be temporary as most of the remaining departments are scheduled to increase in size.

Data on training of geotechnicians in Britain has recently been published by Hunt (1989). There are currently five different courses available, each leading to the qualification of Higher National Diploma. These include:

- General Geological Technology
- Oil Exploration Technology
- Applied Geology with Computing
- Industrial Geology
- Graphical Techniques.

Students come from a wide range of countries, many in fact from Africa and quite a few from

South Asia and Latin America.

We have no actual data on short-course provision in the geosciences and its uptake by overseas students. As far as we are aware, both the number of courses offered and the overseas participation are extremely limited.

Applicants - One Viewpoint

BSc: Detailed information on applications for first degree courses in Geology was not collected, but at Nottingham these have been relatively few in number despite recent overseas recruitment programmes. Some of the factors are probably as follows:

1. The level of fees and maintenance costs is likely to be a deterrent. The overall figure for a three-year degree course is of the order of £25,000 (about US\$40,000).
2. The increasing availability of good degree courses in home or neighbouring countries.
3. Increased competition for overseas students amongst UK universities and polytechnics.
4. The increasing number of students applying to universities in other developed countries.

The experience at Nottingham is that students from developing countries tend to opt for courses in Engineering, Law, Economics and Accounting, rather than Science. Most of our overseas students come from Hong Kong and Malaysia, partly because financial support is more readily available and also because students have taken A-level examinations compatible with the British system. However, there has been a change in the regulations that may have some effect on the pattern of recruitment: previously, overseas students who had completed three years at a secondary school in the UK were classified as home students for the purpose of university admission. Now the criterion is normal place of residence, so such students will be classified as overseas and will therefore have to pay fees at the higher rate.

PhD: Overall there are probably more applications for PhD than for other courses. It is arguable whether or not this reflects the needs of developing countries or the natural aspirations of individuals. The ideal candidate has a clear idea of the area of the subject in which he/she wishes to specialise, has a general plan for a field-based project in his/her home country, and has guaranteed funding. Usually it is helpful if the UK supervisor already has research interests and contacts in that country and is in a position to visit the field area with the candidate: in some instances the needs of field supervision can be met by a senior colleague in that country. In contrast, the most difficult applicants to accommodate are those who are unable to declare any specific area of interest, want a project to be provided in the UK and have no source of funding; they often ask to be considered for a UK univ-

ersity scholarship and, since there are very few of these, competition is severe. Some students in this category apply to a particular university simply because they have friends or compatriots already studying there.

Good PhD projects involving overseas students tend to emerge where the UK supervisor has well-established links with a developing country and already has contacts with staff of a university or geological survey. The project is then planned on the basis of past experience, knowledge of the ground and of the scientific and logistic problems. Colleagues in the developing country can be on the look-out for potential PhD candidates and recommend them when the time comes. There is considerable advantage in the student carrying out a PhD project in his/her home country since the work at least contributes to the geological database of that country; added to which, the post-graduate becomes familiar with the circumstances and environment in which he/she must subsequently be able to operate. However, the home country does not always reap the benefit of this investment on a long-term basis, since some holders of higher degrees may be tempted to work in neighbouring countries where salaries are higher.

Some Problems

1. Despite the efforts of the British Council and others, students from developing countries do not always seem to be directed to the UK university departments best suited to their needs. Many applicants appear to have virtually no information at all on what courses are available at particular universities. Much of the basic essential information is undoubtedly available somewhere but it does not always seem to be accessible to the potential customer. It is doubtful if this is a problem that can ever be entirely overcome, but certainly improvements should be possible.
2. Overseas students often come with a supposedly adequate knowledge of the English language but find themselves in difficulties when they arrive. Examiners are willing to make some allowances for the fact that a thesis has been written in a foreign language but it undoubtedly generates an additional hurdle for candidates and perhaps also prevents them deriving as much benefit from their stay as they might otherwise have done. Such students should be prepared to acknowledge their limitations in this respect at an early stage and should be encouraged to take an English language course before embarking on an MSc or PhD. Appropriate courses are on offer at UK universities nowadays, but many students are reluctant to take advantage of them. In many

cases it is the oral rather than the written English that causes problems (in lectures, for example). Individual departments may be able to help in this regard by providing opportunities for group discussions, both general and specific, at a very early stage in the course.

3. Overseas students are often very single-minded in their dedication to a chosen course of study, sometimes sacrificing other possibilities that may be on offer. It is especially important that they are encouraged to participate in a wider sphere of scientific activities such as seminars and conferences. They should also make every effort to attend talks by guest speakers visiting their department, even though most topics may be outside their immediate area of interest. The same considerations also apply to UK students, but for overseas students these are opportunities that may not be available to them in the future.
4. There is a particular difficulty when groups of students from a single overseas country are studying together in one UK department. They will often share accommodation and spend much of their time as a group but in doing so will gain less benefit from their period of study abroad. Mutual support provides some comfort and it is undoubtedly more difficult initially for the solitary overseas student but, in the end, the latter will derive more lasting benefit from integrating more fully within the community.
5. Providing suitable accommodation for overseas students is rarely easy. Halls of Residence do their best but it is not always possible to satisfy a range of dietary preferences on a continuous rather than intermittent basis. Many overseas students recognise the problem and are able to adjust; but some do not. Economic pressures mean that halls of residence often close for parts of the year or use their accommodation for conferences; this poses a special problem for overseas students, many of whom have no alternative accommodation to go to. One solution is to retain one residence for the use of overseas students during such occasions. The Christmas vacation is the most difficult time, but universities are now making great efforts to overcome this and more and more overseas students are being invited as the guests of families over this period.
6. A more fundamental problem, perhaps, is that there are relatively few geoscience courses on offer that are truly suitable to the needs of the overseas student. Many such students graduated some years ago in their home countries with a standard and style of education quite different from those in Britain. On the whole they will be less adept at examination techniques and, indeed, conventional forms of

assessment by examination may be unsuitable for those with several years of experience as professional geologists. Attempting to fit these students into one of the normal British Geology courses is often not appropriate. More pre-intake discussion with the students or sending institutions, greater flexibility in existing course structures and assessment methods, and more purpose-designed courses should go some way to alleviate these problems.

Education Through Collaboration ... Some Solutions?

The question that must now be asked is what extent the current UK provision meets the requirements of developing countries for increased access to higher education in geoscience. The simple but, we believe, honest answer is: "not very well". A more positive answer would be that Britain has tremendous *potential* to improve this provision and to collaborate with developing countries for long-term growth in geoscience education options. However, some radical rethinking is required as well as an increased input of resources into higher education in Britain. The results would be mutually beneficial to all parties concerned.

The reasons for our statement that the provision does not match the requirements can be simply put:

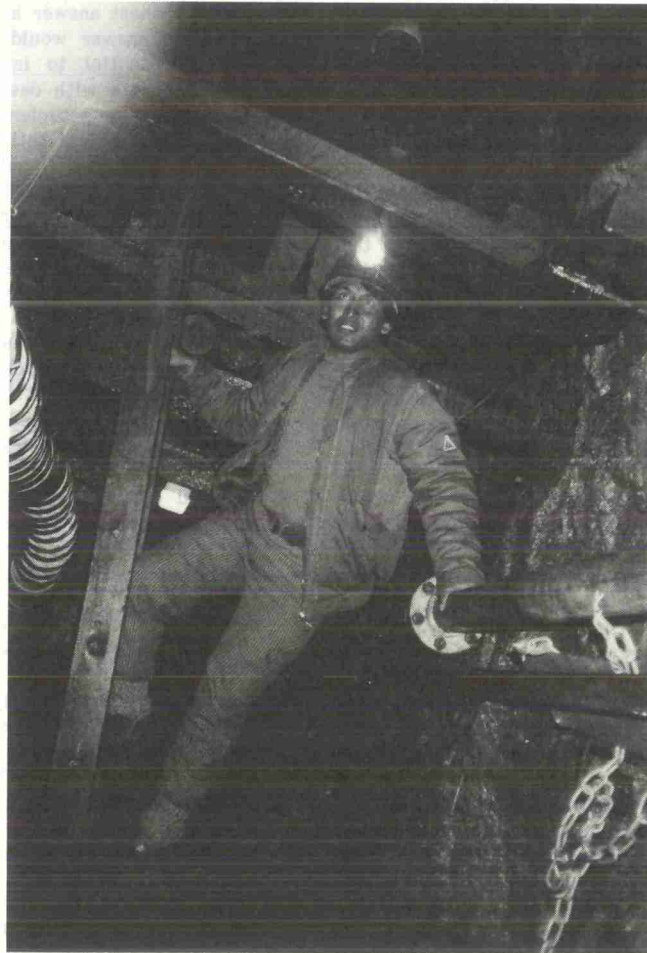
1. The total number of overseas students who finally come to Britain for further training in geoscience is very small compared with the numbers that need training, and also compared with the numbers that find their way eventually to other developed countries (especially the USA, Canada, Australia, Federal Republic of Germany, France and the Netherlands).
2. The full costs of higher education in Britain have escalated considerably (particularly the fees element) without a corresponding increase in the number of scholarships sponsored by British Council, industry or others. As a result, we attract only a small proportion of students, mostly from relatively rich nations that can afford to pay.
3. Perhaps more significantly, any nation intending to develop its geoscience expertise by overseas training, and any independent funding agency (e.g. UNESCO, The World Bank) that offers scholarships, must weigh very carefully what they pay. We suggest that the provision in the UK has fallen behind what it could and should be, that Britain has to some extent rested upon its former reputation as the centre for higher education, and that we do not at present direct sufficient attention to the special needs and requirements of the overseas student in general as well as in geoscience.

It is possible to offer some remedies, however, particularly with regard to the quality of the education service we offer to overseas students. We outline the elements of two possible avenues along which beneficial developments might be made.

1. **Institution Twinning.** Some needs of developing countries may be met by short courses given by expatriate staff - generally from developed countries - especially where practical problems are best addressed on the ground, e.g. in the case of hazard evaluation and risk management. However, this fulfills a requirement that is different from the longer-term objective of a protracted span of study overseas. A sustained period of education/training in well-equipped and well-staffed

institutions in a more developed country is likely to provide the best solution. Nevertheless, isolated training of this kind loses some of its value unless there is an opportunity for the returning graduate to put his/her training into practice. Growth and development must be achieved at home if there is to be any lasting benefit from the training received overseas.

The best results are most likely to be achieved through building close links between related university departments in the UK and a developing country. This would involve interchange of staff, perhaps with those from the developing country either reading for a degree or taking study leave in the UK. Similarly, staff from the UK department would be en-



Bangladeshi students on a Geological Exploration Methods MSc course at the University of Nottingham gained practical experience of a copper mine in Cornwall, southwest England - Great Condurrow Mine, a training mine for geologists and others in the Camborne School of Mines

gaged in research projects and give guest lectures in the developing country. Research students from the UK and from the developing country would do field work in the latter and laboratory work in the UK. But ideally there would be an informal partnership or departmental twinning with the exchange of information, e.g. lists, syllabus, and with the UK department offering analytical and other services wherever possible. A close association of this kind requiring a long-term commitment to material help and guidance from the UK department is one of the most effective ways forward.

2. **International Training Centres.** A more ambitious option would be to develop in Britain a series of international training centres (ITCs) along the lines of those in the Netherlands, some of which have been in operation now for over 25 years. These have proved to be an extremely effective contribution to international development co-operation through scientific and technical training at post-graduate level (Diederix, 1990, this volume). The basic concept for the geosciences would be to develop an interdepartmental and interdisciplinary unit within a university that could draw upon the expertise and resources of several related departments (e.g. geology, physical geography, geophysics, oceanography, geochemistry, environmental sciences, engineering). The unit would aim:
- To offer overseas students and professionals appropriate training in the latest concepts, methods and applications within the earth sciences, through diploma and MSc taught courses, PhD and post-doctoral research opportunities and a wide-range of short courses.
 - To develop and undertake co-operative research projects with scientists from developing countries and to act as an international centre for visiting geoscientists.
 - To develop more appropriate educational methods for overseas students in the UK and, in the longer term, to co-develop sister ITCs in different parts of the developing world.

The important difference between the ITC concept and what we have for the most part at present in Britain would be:

- a specific focus on training for and co-operation with developing countries;
- active discussion in advance and at all stages of how to match requirements of the sending nation with provision by the ITC; and
- a firm commitment to the rapid development of adequate facilities for geoscience training in all parts of the world.

There is scope in Britain for the introduction of several ITCs at different universities, each with a distinctive focus or specialisation. Examples might include earth and marine sciences, geological mapping, mining engineering and geology, petroleum geology, and remote sensing in earth science, as well as more traditional mainstream geology.

There is already considerable interest in this idea in other parts of the world besides the Netherlands. In Australia, the University of New South Wales has recently established the Key Centre for Mines International (Katz, 1990, this volume). In Finland, there are proposals to have a permanent mineral resources research and teaching unit at the University of Oulu (Laajoki, personal communication, 1989), and in Italy to develop an earth-science institute parallel to the very successful International Centre for Theoretical Physics in Trieste.

Most importantly, the Netherlands ITCs have shown the effectiveness of their policy of promoting the establishment of sister institutes in developing countries (Diederix, 1990) where similar educational and research programmes can operate on a more regional scale. The importance of developing well-staffed and well-equipped centres for geoscience education in developing countries was repeatedly stressed by the participants at a *Symposium on Earth Science Education in Developing Countries* held in Sydney, Australia, in 1976 (Cooray, 1977). This long-term objective must always remain the highest priority.

Acknowledgements

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References

- Cooray, P.G., 1977 (editor). *Geoscience Education in Developing Countries*. The Geosciences in International Development Report No 5, AGID, Bangkok, Thailand, 56 p.
- Diederix, H., 1990. Partnership in geoscience education for the Third World. In: *Geosciences in Development*, D.A.V. Stow and D.J.C. Laming (editors), AGID/Balkema Publishers, Rotterdam, Netherlands.
- Fyrthe, H.J., and Goldsmith, M., 1973. *Science, History and Technology*, Book 1: AD800 to the 1840s. Cassell, London, 260 p.
- Hunt, B.N.F., 1989. Geology technicians need training too. *AGID News*, no 58, 0 17-18.
- Katz, M.B. 1990. KCMi: a regional mineral education centre for Asia and the Pacific. In: *Geosciences in Development*, D.A.V. Stow and D.J.C. Laming (editors), AGID/Balkema Publishers, Rotterdam, Netherlands.

Stow, Dorrik A.V. & Deryck J.C. Laming (eds.) 90 6191 176 1
Geosciences in development – *Proceedings of an international conference on the application of the geosciences in developing countries, Nottingham, 26 – 29 September 1988*
1991, 25 cm, 343 pp., Hfl. 125 / \$70.00 / £39
Geoscience education and institution building; Hydrogeology; Engineering geology and geological hazards; Economic minerals and exploration techniques; Mapping, exploration and energy resources; Conclusions. 39 papers. Editors: Univ. Southampton and Herrington Geoscience, Exeter.

FROM THE SAME PUBLISHER:

Dearman, W.R., E.M. Sergeev & V.B. Shibakova (eds.)
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Engineering geology of the earth
1989, 25 cm, 247 pp., Hfl. 80 / \$40.00 / £25
Publication of the International Association of Engineering Geology (IAEG). Classification of engineering geological conditions of the earth; Engineering geology of the permafrost zone & selected permafrost regions; Arid regions; Engineering geological characteristics of loess deposits of the northern Hemisphere; The tropical environment; The continental shelf; Engineering geology of mountain regions; Engineering geology of the Alpine-Himalayan belt; Other mountain regions; References. Editors: University Newcastle upon Tyne, UK, Moscow University and Academy of Science, USSR.

Ladeira, Eduardo A. (ed.) 90 6191 195 8
Brazil Gold '91 – *The economics, geology, geochemistry and genesis of gold deposits* – *Proceedings of the symposium Brazil Gold '91, Belo Horizonte, MG, 13–17.05.1991*
1991, 25 cm, 844 pp., Hfl. 165 / \$95.00 / £50
Gold and gold deposits are one of the main focuses of pure and applied research in geological science at the present time. At the International Symposium *Brazil Gold '91*, participants from 23 countries and with a wide variety of research interests joined to present and discuss their latest contributions on the economics, geology, geochemistry and exploration of gold deposits. The proceedings of *Brazil Gold '91* encompass 117 papers which are distributed in five sections: Regional studies; Petrology and geochemistry; Geology and case studies of gold deposits; Structural geology of gold deposits and districts; and Mineral exploration. They will be very useful for professional geologists, geophysicists and mining engineers concerned with precious metal deposits, whether working in research and development, industry, or mineral exploration. It will certainly also be an essential source for both undergraduate and graduate students in economic and applied geology.

Kesse, G.O. 90 6191 589 9
The mineral and rock resources of Ghana
1985, 25 cm, 624 pp., Hfl. 245 / \$138.00 / £70
Importance of minerals; Ghana: Geography, physiography, geology & geohydrology; Mineral resources of Ghana: background; Metallic & non-metallic minerals; Bulk construction materials; Radioactive minerals; Petroleum & other fossil fuels; Minor minerals; Minerals in concentrates; Tables of summary of mineral & rock resources in Ghana; Legislation affecting mineral concessions & mining industry; Index. Author: Director Geological Survey Department of Ghana.

Wunderlich, Walter O. & J. Egbert Prins (eds.) 90 6191 695 X
Water for the future: Water resources development in perspective – *Proceedings of the international symposium on water for the future, Rome, 6–11 April 1987*
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1987, 25 cm, 717 pp., Hfl. 165 / \$90.00 / £52
History; Urban & rural water law, policies & institutions; Managing existing water resource systems; Future challenges; Ground-water developments; Alternative water developments.

Tsakiris, G. (ed.) 90 6191 184 2
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The 70 papers included in this volume were carefully selected and assess the current state-of-the-art in the following subjects: Surface water; groundwater; water resources conservation; water quality and re-use; computer modelling and simulation; real time control of water resources systems; institutions and methods for technology transfer (future developments in water resources technology and management in Europe and the world). In the latter papers research institutions, universities and companies involved in water resources technology are widely represented.

Plotnikov, N.I. & I.I. Roginets 90 6191 900 2
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(Russian translations series, 72) (No rights India)
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General hydrological conditions; Study of hydrological conditions at stage of exploitation of ore deposits; Analysis of influence of exploitation of ore deposits on changes in the geological environment.

Ghose, A.K. (ed.) 90 6191 498 1
Strategies for exploitation of mineral resources in developing countries – *Proceedings of the international symposium, Dhanbad, 6–8 November 1986*
(Indian edition series, 16) (No rights India)
1987, 30 cm, 286 pp., Hfl. 125 / \$70.00 / £39
Mineral development strategies in developing countries; Smallscale mining worldwide; Mineral development in LDCs; Ecological disturbances; Petroleum strategies; Offshore oil pollution; etc. 28 papers from Australia, Brazil, India, Indonesia, Pakistan, UK & USA.

Akramkhodzhev, A.M., V.A. Babadagly & A.D. Dzhumagulov
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Geological structure of deltas; Thermodynamics & geochemistry of sedimentary rocks; Generation & accumulation of hydrocarbons; Oil- & gas-bearing ancient deltas in the USSR & other countries; Methods of studying the oil & gas potential of ancient deltas; Conclusions; References.

90 6191 615 1
The development science and art of minerals surveying
Proceedings of the 6th international congress of the International Society for Mine Surveying, Harrogate, 9–13 September 1985
1985, 25 cm, 1098 pp., 2 vols, Hfl. 275 / \$150.00 / £87

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