AGC Recommendations on the General Syllabus for an Undergraduate Degree in the Geosciences

Disciplines evolve and so must the syllabus offered to those training to enter professional life in those disciplines. Geoscience is no different from the other fundamental sciences in this evolution, with a progressive blurring of the boundary between the classical geology, physical geography and associated fields over the last 20 years, leading to some debate over the difference between a “geoscience” and an “earth science” qualification.

Part of the evolution relates to the nature of the science itself and the need for integration of teaching and research that spans rocks, regolith, water and even the atmosphere. Part of it relates to the rise of new technologies, including remote sensing and GIS. Part of it relates to the contraction of staff numbers in universities and the need to broaden the range of elective courses that students can draw upon to complete their geoscience degrees (the days of having four specialist petrologists on staff are probably gone forever).

Unlike many other professions we (certainly the universities) have tended to oppose formal accreditation of academic programs by external bodies, let alone government-sanctioned professional registration requirement. No university in their right mind would ever volunteer to have external regulation of their syllabus. However, this does not mean we should shy away from defining the core competencies and knowledge, and range of specialisation areas, that we might agree are necessary for a major to be defined as “geoscience” or a graduate to be able to label themselves a “geologist” and obtain employment in areas such as the resources sector.

The question is whether we can (or even should) agree on a generic syllabus spanning geology, associated sciences and other professional skills, that a university program should meet. The AGC has considered this question, with input from a number of its society representatives, and proposes the attached model which encompasses geological fundamentals (the core), specialist or extension areas, general scientific literacy and generic skills. We have also suggested the minimum entry requirements from high school.

The AGC invites comment on this model.

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AGC-RECOMMENDED SYLLABUS FOR AN UNDERGRADUATE DEGREE IN GEOSCIENCES

SENIOR HIGH SCHOOL		
Chemistry - Atomic model; bonding; reactions and stoichiometry; basic thermodynamics and equilibrium; analytical methods; lab skills	**Mathematics -** Algebra and equation solving; basic calculus; geometry and trigonometry; indices; graphs; problem solving	**Earth science**s - where available **Physics** – especially for those going into geophysics or engineering geology

CORE CONTENT	EXAMPLES OF ADVANCED OR SPECIALIST CONTENT (typically Level 3 or Honours electives and with varying availability)	GENERIC SKILLS (possibly embedded in subjects/courses)
Tectonics and Earth History - Origin and evolution of the earth, evolution of life and the atmosphere	**Advanced Tectonics** - Crustal processes; structural analysis at mineral to continental scales; evolution of the Australian continent; modelling; case studies	**The Scientific Method and Philosophy of Science** - General scientific literacy and understanding the strengths and limitations of the method
Mineralogy; Igneous, Sedimentary and Metamorphic Petrology - Formation and classification of the major rock types and formation processes, including capabilities in examination of rocks and minerals in hand specimens, thin and polished sections, and handling of data from XRD and related common analytical methods	**Advanced Mineralogy and Petrology** - more detailed examination of igneous, sedimentary and metamorphic processes; advanced analytical methods; applications and case studies	**Data Acquisition and Analysis -** Advanced level statistics, sampling theory and experimental design, database management, data visualisation, geostatistics, GIS and remote sensing
	Sedimentology/Basin Analysis - Course may be linked to petroleum geology	**Project Management** - including teamwork, fundamentals of resource economics and budgets
Life through Time - General introduction to invertebrate and vertebrate palaeontology; evolution of life; extinction events; stratigraphy	**Advanced Palaeontology / palynology** - Course may be linked to petroleum geology	**Communication Skills** - proposals, reports, oral and visual presentations, scientific papers
	Geochronology and Isotope Studies	**Industry or Research Placements and Professional Practice**
Geochemistry - Distribution of elements in the Earth's crust; chemical processes in the litho-bio-atmosphere; use of isotopes; mineral-forming processes	**Exploration and/or Environmental Geochemistry** - Geochemical processes in primary and secondary environment; behaviour of elements, organics and other materials; sampling and analysis; QC; fieldwork; case studies	
Geomorphology and Hydrogeology - Regolith and landforms; groundwater flow and modelling; ground and surface water resources	**Advanced Geomorphology and Regolith** - Types of regolith and distribution; economic significance; environmental management issues	
	Hydrology - Hydrologic cycle, water resources, precipitation, water shed, drainage basins, recharge	
Structural Geology - Tectonics; types of deformation; recognising and measuring structural elements of single or multi-phase deformation; stereographic projections; case studies; fieldwork	**Advanced Structural Geology** - deformational history; macro and micro structures, kinematics and stress fields; field mapping exercises	

Geophysics (introductory) - geophysics of the earth including gravity, magnetics, seismic and electrical characteristics; crustal scale mapping and plate tectonics including seismology	**Advanced Geophysics** - Geological applications including crustal mapping, mineral and groundwater exploration; forward / inversion modelling, visualisation, interpretation; fieldwork; case studies	**OTHER DISCIPLINES**
Remote Sensing and GIS (introductory) - Acquisition and processing of data; use of software packages; spatial data integration; geostatistics	**Advanced GIS / RS and Computer Modelling -** Remote sensing and imaging; processing of spatial data and graphical representation; construction and maintenance of databases	**Chemistry** - Some tertiary level chemistry is highly desirable for geology (especially mineralogy and petrology), geochemistry and hydrogeochemistry
	Advanced Statistical Methods - Experimental design, multivariate methods; hypothesis testing and modelling; parametric and non-parametric methods; metadata analysis; Bayesian methods	**Mathematics and Statistics -** Tertiary level studies involving statistical analysis, sampling theory and programming skills are highly desirable. Applied mathematics is essential to geophysics
	Ore Deposits - Geological setting and processes of ore formation; major genetic types; economic deposit suites; environmental issues; exploration methods; case studies	**Physics -** desirable for all but may be essential for engineering geology, geophysics, hydrology and nuclear fuels
	Energy Fuels - Geological setting & process of coal and hydrocarbon deposit formation; environmental issues; exploration methods; case studies; uranium.	**Biology -** desirable for all, especially when related to understanding aspects of earth history and the modern environment; may be essential for advanced palaeontology
	Mining Geology - Geological mapping and surveying, sampling, block modelling and resource estimation, grade control, reconciliation and mining methods, rehabilitation	**Economics / Commerce -** Introduction to micro and macro economics and business concepts and processes
	Engineering Geology - may be combined with other courses relevant to mining geology	**Languages** - for those wanting to work outside English-speaking regions
Field Mapping - Constructing lithological and regolith maps; field identification of minerals, rock types, structures and other features; mapping technologies and software; developing geological histories	**Independent Research Project(s)** - typically in the form of an honours year with design, implementation and reporting requirements	