Course Description / Who Should Attend:

This 5-day workshop is made up of a series of one-day courses taught by leading researchers in the fields of rare earth and precious metals. The topics are current with respect to deposit types, genesis, and exploration criteria and the workshop is designed for professional geologists and senior graduate students.

Topic: Rare Earth Resources: demand and supply situation, deposit types, and exploration and mining criteria

Presenter: Yasushi Watanabe (June 18, 2012)

Description: Rare earth resources have been mainly produced from carbonatite and ion-adsorption deposits in China. Recent decreased amounts of rare earths available outside China have resulted in soaring rare earth prices and widespread global exploration. However, development of rare earth projects is not simple. Rare earth projects should be evaluated by many different factors, not only from ore grade and reserve tonnage, but also from mineralogy, rare earth composition, grain size, amounts of radioactive elements, by- or co-production of other elements, and accessibility of cheap chemicals. This course will cover the present demand and supply situation, rare earth deposit types, and explain the criteria for the development of resources.

Yasushi Watanabe is a senior research geologist of the Geological Survey of Japan, where he has been working for 27 years. He has conducted numerous geologic and metallogenic studies of epithermal and porphyry Cu deposits in the circum-Pacific. More recently, he has been involved in rare earth and rare metal resource assessment projects by the Japanese Government, private exploration, and trading and manufacturing companies since 2005. He has evaluated many rare earth deposits throughout the world and continues consulting work on several on-going rare earth projects. He is presently Vice President of SEG, an editorial board member of Economic Geology, and editor-in-chief of Resource Geology.
**Topic: Iron Oxide-Copper-Gold Systems: Geology and Metallogenesis**

**Presenter: Brian Rusk (June 19, 2012)**

Description: IOCG deposits comprise a wide range of deposits whose primary shared characteristic is the presence of iron oxide (either magnetite or hematite) in association with Cu and Au and in some cases P, F, and REE. Understanding the processes by which these deposits form has proven a major challenge and it is likely that deposits formed by distinct processes in differing tectonic environments are represented within this broad category. The boundaries between the different end member types, however, are not always clear in terms of physical characteristics or physiochemical processes of ore genesis. Even with recent analytical advances and numerous compilations published, IOCG and related deposits remain one of the least understood classes of ore deposits.

In this course, we will review current understanding of the geology and exploration characteristics of IOCG deposits, with emphases on metallogenesis and examples of world-class districts. We will compare IOCG systems in terms of alteration zoning, mineralization styles, geochemical footprints, fluid regimes and ore deposition processes. Several genetic models will be presented to explain the vast diversity among deposits within this broad ore-type. Potential exploration vectors will be discussed as will the role of geology in increasing effectiveness of exploration for IOCG deposits, both under cover and in well-exposed settings.

Brian Rusk received his Ph.D. from the University of Oregon in 2003, where he studied the genesis of the famous Butte, Montana porphyry copper deposit. He applies both field studies and microanalysis to understanding of the formation of hydrothermal ore deposits. He specializes in the application of mineral geochemistry and fluid inclusion microanalysis to understand the evolving pressure-temperature- and composition of hydrothermal fluids in ore-forming environments. Brian's initial research led to significant advances in our understanding of the origins and compositions of fluids that form porphyry Cu (Au-Mo) deposits. He has spent the better part of the previous four years, as a research associate at James Cook University in Australia, studying iron oxide-Cu-Au (IOCG) systems, with a focus on the systems in the Cloncurry region of Australia and the Carajas region of Brazil. Brian is an expert in numerous advanced laboratory microanalytical techniques including, fluid inclusion, LA-ICP-MS, cathodoluminescence, and isotopic analysis. For his contributions to our understanding of fluids in hydrothermal systems, Brian recently received both the Brian Skinner award and the Waldemar Lindgren award by the Society of Economic Geologists. He is currently a research associate at Western Washington University, in Bellingham, WA and consults to industry, government and academics alike.

**Topic: Carlin-type Gold Deposits: Geology, Genesis, and Exploration**

**Presenter: John Muntean (June 20, 2012)**

Description: Carlin-type gold deposits in Nevada, USA, with a total endowment over 200 Moz of gold, comprise Earth's second largest concentration of gold after South Africa. Despite their importance, the origin of these deposits remains enigmatic. This course first focuses on Nevada's tectonic evolution that produced an ideal geologic setting for formation of Carlin-type deposits in the Eocene. Detailed descriptions of deposit geology will follow, including structure, lithology, ore-stage and late-ore stage mineralogy, and related hydrothermal alteration and trace element patterns, and their implications for exploration. Given all the presented data, genetic models will then be considered, concluding with a discussion of the possibility of large districts of Carlin-type deposits outside Nevada.

John Muntean is a Research Economic Geologist and Associate Professor with the Nevada Bureau of Mines and Geology at the University of Nevada Reno. He received his BS from Purdue University,
his MS from the University of Michigan, and his Ph.D. from Stanford University. Before joining UNR in
2005, John worked 12 years in the mining industry for companies including Santa Fe Pacific,
Homestake and Placer Dome, mainly exploring for gold in Nevada. His research has been on
dpithermal and porphyry gold deposits, specifically Pueblo Viejo and the Maricunga belt, but, for the
last 14 years, he has focused on Carlin-type gold deposits.

**Topic: Epithermal Deposits: Geological Characteristics and Genetic Processes for Exploration
and Discovery**

**Presenter: Stuart Simmons (June 21, 2012)**

Description: Epithermal deposits are diverse and attractive exploration targets for precious metals
because they can contain high metal grades and large resources, and they can overlie deep porphyry
mineralization. This course focuses on the geological characteristics of epithermal deposits, their
hydrothermal alteration patterns, and the processes that produce them. The topics include: geological
settings and controls on mineralization, hydrothermal minerals and their zonation, precious-metal
transport and deposition, spatial and temporal scales of mineralizing processes, exploration strategies,
and case studies. Emphasis is placed on understanding the exploration potential of a project and
the depth-level of erosion. The course outline is 1. Epithermal Deposits, 2. Modern Environments,
3. Precious Metal Transport and Deposition, 4. Hydrothermal Alteration Patterns, 5. Exploration
Considerations.

Stuart F. Simmons is a Research Professor (Geology and Geological Engineering, Colorado School
of Mines) and a consulting geoscientist, with >30 years of research experience on hydrothermal
processes, epithermal mineralization, and geothermal resources. He has a Ph.D. in Economic
Geology (University of Minnesota), and much of his professional career was spent in New Zealand, at
the Geothermal Institute, University of Auckland. As a consultant, he serves clients around the Pacific
rim in the exploration and development of gold-silver and geothermal resources. For more information
see www.hotsolutions.co.nz.

**Topic: Orogenic Gold Deposits: Geology, exploration criteria, and global distribution**

**Presenter: Richard J. Goldfarb (June 22, 2012)**

Description: Orogenic gold deposits, or gold deposits in metamorphic rocks, are spatially and
temporally the most widespread major deposit type hosting large gold resources. This course will
focus on the geology of these Archean through Tertiary ores, the key features to use in targeting
these ores in an exploration program, and processes of ore formation that are critical to understanding
where such resources are likely to be best located. Important deposits and districts from throughout
the world will be compared and contrasted to help define broad areas of highest favorability for
discovery of new resources.

Richard J. Goldfarb is a senior research geologist with the Minerals Program of the U.S. Geological
Survey, where he has been employed for more than 32 years. His major expertise has been on the
geochemistry and geology of ore deposits with emphasis on Phanerozoic orogenic gold. Much of
his earlier career work was concentrated on the Tertiary orogenic gold deposits of southern Alaska.
Results from this work were used to develop ore genesis models for giant gold deposits elsewhere
in Alaska and in other parts of the North American Cordilleran. In recent years, Rich has conducted
detailed studies on the understanding of the distribution of orogenic gold deposits through space
and time, compiling the most comprehensive global description of their distribution and evaluating
the controlling tectonic/geologic features. He has senior-authored and co-authored more than 195 refereed publications in economic geology. Rich has served as President of the Society of Economic Geologists, is a past Silver Medalist and Thayer Lindsley lecturer of the society, has served as chief editor of Mineralium Deposita, is presently on the editorial boards of Economic Geology, GEEA, and Gondwana Research, and was one of the co-editors of the Economic Geology One Hundredth Anniversary Volume.

**Registration Fees**

**Early registration deadline: May 15, 2012**

Members (US$ 1,595)
Non-Members (US$ 1,695)
SEG Students (US$ 895)
Non-Member Students (US$ 945)

**Late registration: after May 15, 2012**

Members (US$ 1,695)
Non-Members (US$ 1,795)
SEG Students (US$ 945)
Non-Member Students (US$ 995)

*Please note that this course is limited to 50 participants. SEG reserves the right to cancel this event should minimum attendance numbers not be met by May 15, 2012.*