

---

**International course on**  
**Ore Deposit Models and Exploration: Base and Precious Metal**  
**Deposits**

**1-7 Oct. 2016, Tehran, Iran**

**Organizer:** Samaneh Kamsar Zamin (SKZ)

**Sponsor:** Iranian Mines & Mining Industries Development & Renovation Organisation  
(IMIDRO)

**Instructors:**



Jeremy P. Richards: Porphyry and Epithermal Deposits (Professor of University of Alberta, Department of Earth and Atmospheric Sciences)



Richard Goldfarb: Orogenic Gold Deposits (U.S. Geological Survey (Retired), Professor of Colorado School of Mines)



David L. Leach: Mississippi Valley-Type (MVT) Deposits (U.S. Geological Survey (Retired), Professor of Colorado School of Mines)



David Lowell Huston: Volcanogenic Massive Sulfide (VMS) Deposits (Principal Research Scientist, Resources Division, Geoscience Australia)

## Course info:

No.	Course	Instructor	Date	Venue	Cost (USD)	
					Student	Non-student
1	Orogenic Gold Deposits	R. Goldfarb	1-Oct	IMIDRO Conference Hall, Tehran, IRAN	100	150
2	Porphyry Deposits	J. Richards	2-Oct	IMIDRO Conference Hall, Tehran, IRAN	100	150
3	Epithermal Deposits	J. Richards	3-Oct	IMIDRO Conference Hall, Tehran, IRAN	100	150
4	MVT Deposits	D. Leach	4-Oct	IMIDRO Conference Hall, Tehran, IRAN	100	150
5	VMS Deposits	D. Huston	5-Oct	IMIDRO Conference Hall, Tehran, IRAN	100	150
6	Field Trip	D. Huston	6-Oct	Kushk Zn-Pb Mine, Bafq, IRAN	250	350
7	Field Trip	R. Goldfarb	6-Oct	Muteh Gold Complex, Isfahan, IRAN	250	350
8	Field Trip	D. Leach	7-Oct	Irankuh Zn-Pb Mines, Isfahan, IRAN	250	350
9	Field Trip	J. Richards	7-Oct	Kahang Cu Porphyry Deposit, Isfahan, IRAN	250	350

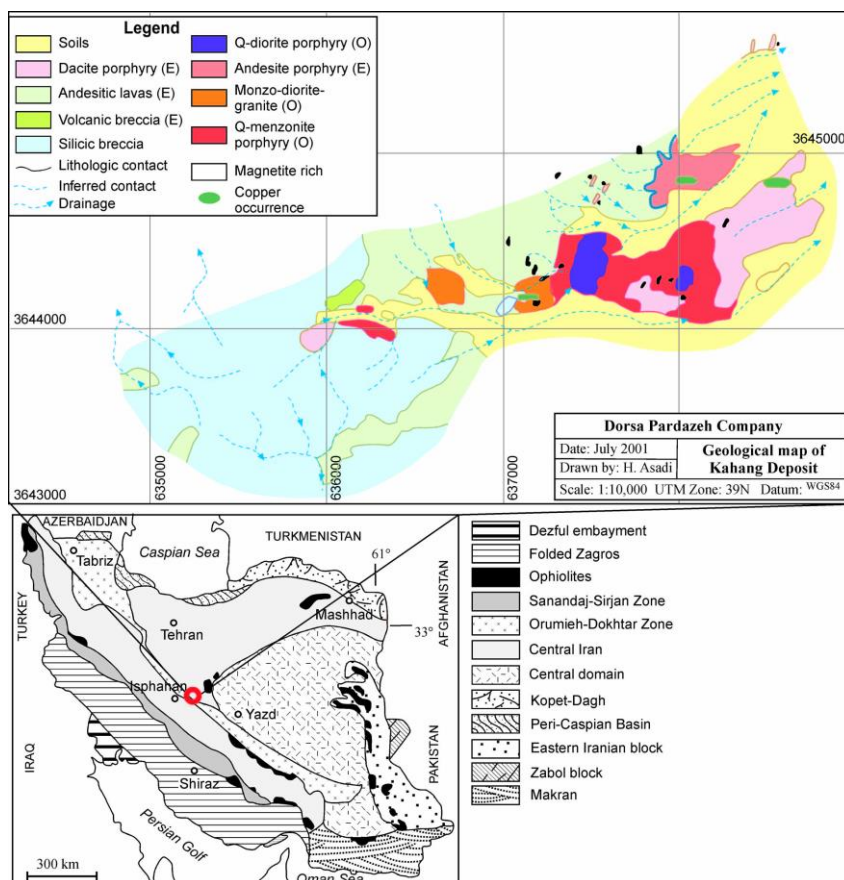
## Terms and Conditions:

- All fees are VAT included.
- Registration of all theoretical courses (1-5 Oct. 2016) receives 20% discount.
- Registration of two field trips receives 5% discount.
- Registration of all theoretical courses (1-5 Oct. 2016) and the two field trips (6-7 Oct. 2016) receives 30% discount.
- Field trips are subject to cancellation 30 days prior to the event if the minimum number of participant is not met.
- Registration fees include:
  - o Attendance to the course
  - o Course package, including copies of manuals
  - o Certificate of attendance
  - o Lunch and tea/coffee
  - o Shuttle bus transportation for field trips from Yazd/Isfahan to Kushk, Muteh, Irankuh, Kahang sites and return to Yazd/Isfahan
  - o Light meals and refreshments during field trips

## Field trips:

### 1. Kahang Cu-Mo±Au Porphyry Deposit (led by J. Richards)

The Kahang deposit is located about 73 km NE of Isfahan in Central Iran. This deposit contains more than 100 million tonnes of sulphide ore with an average grade of 0.5 % Cu and 90 ppm Mo according to the NICICo latest exploration results (Afzal et al. 2012; 2013). The deposit is situated in the Cenozoic Urumieh-Dokhtar magmatic belt. This deposit is mainly composed of Eocene volcanic-pyroclastic rocks, which were intruded by quartz monzonite, monzogranite-diorite to dioritic intrusions in Oligo-Miocene rocks. The extrusive rocks, including tuffs, breccias and lavas are dacitic to andesitic composition. On the other hand, these intrusions are roots of acidic to intermediate domes in the Kahang porphyry deposit. The main structural features are two fault systems trending NE-SW and NW-SE. The major alteration zones of potassic, phyllic, argillic and propylitic types were accompanied by vein to veinlets fillings of quartz, quartz-magnetite and Fe-hydroxides. Mineralization within intrusive bodies and their surrounding host rocks consists of chalcocite, chalcopyrite, pyrite, malachite, magnetite, limonite jarosite, goethite and chalcantite in quartz stockworks and advanced argillic alteration (Afzal et al. 2010; Yasrebi et al. 2013).



*Geological map of the Kahang deposit within the Urumieh-Dokhtar volcanic belt in the structural map of Iran (modified based on Tabatabaei and Asadi Haroni (2006) by Yasrebi et al. 2013)*

You can see the following references for this deposit:

- Afzal, P., Khakzad, A., Moarefvand, P., Rashidnejad Omran, N., Esfandiari, B., Fadakar Alghalandis, Y., 2010. Geochemical anomaly separation by multifractal modeling in Kahang (Gor Gor) porphyry system, Central Iran, Journal of Geochemical Exploration 104, 34–46.
- Afzal, P., Fadakar Alghalandis, Y., Moarefvand, P., Rashidnejad Omran, N., Asadi Haroni, H., 2012. Application of power-spectrum-volume fractal method for detecting hypogene, supergene enrichment, leached and barren zones in Kahang Cu porphyry deposit, Central Iran, Journal of Geochemical Exploration 112, 131–138.
- Afzal, P., Harati, H., Fadakar Alghalandis, Y., Yasrebi, A.B., 2013. Application of spectrum–area fractal model to identify of geochemical anomalies based on soil data in Kahang porphyry-type Cu deposit, Iran. *Chemie der Erde/Geochemistry* 73: 533– 543.
- Tabatabaei, S.H., Asadi Haroni, H., 2006. Geochemical characteristics of Gor Gor Cu–Mo porphyry system. 25th Iranian Symposium on Geosciences, Geological Survey of Iran, pp. 60–63. In Persian with English abstract.
- Yasrebi, A.B., Afzal, P., Wetherelt, A., Foster, P., Esfahanipour, R., 2013. Correlation between Geological and Concentration-Volume Fractal Models for Cu and Mo Mineralised Zones Separation in Kahang Porphyry Deposit, Central Iran. *Geologica Carpathica* 64 (2), 153—163.

## 2. Muteh gold complex (led by R. Goldfarb)

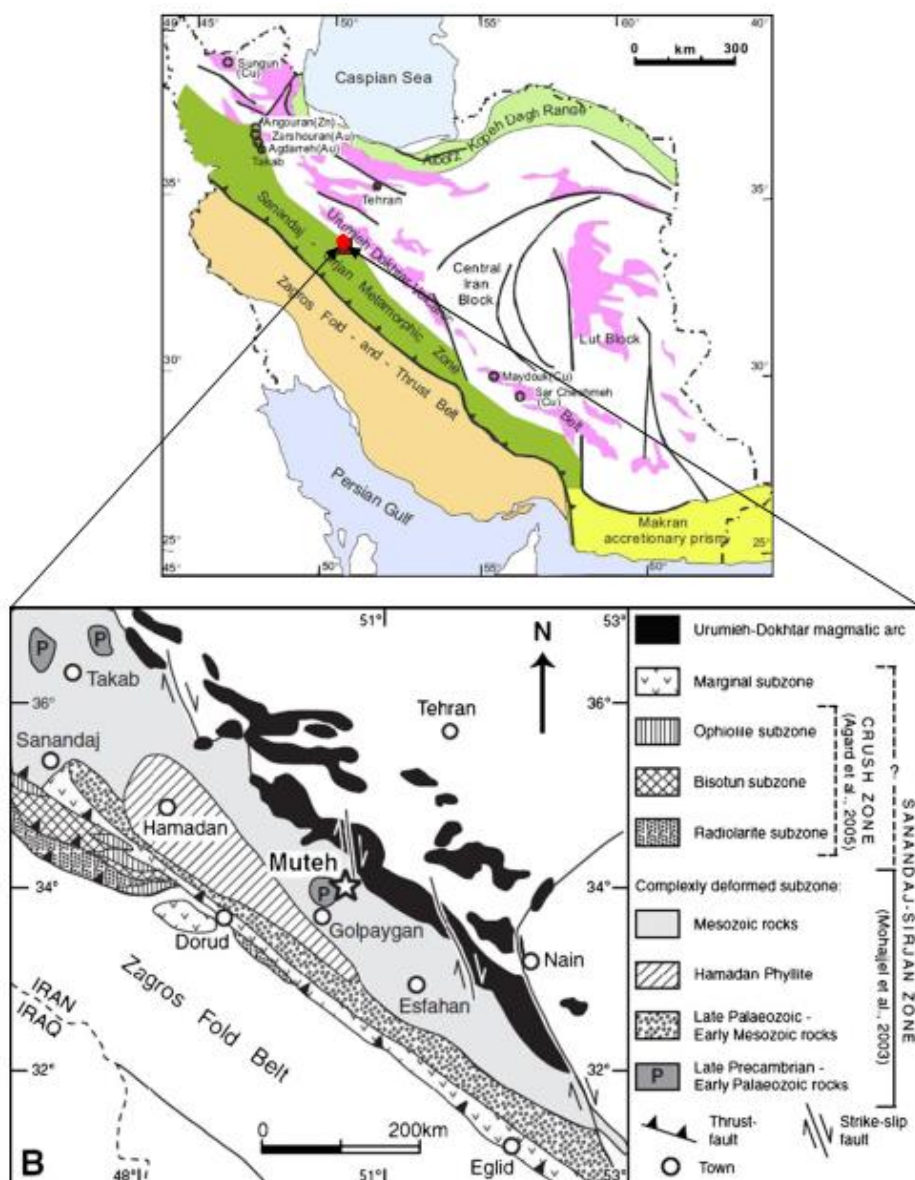
Muteh gold complex is located 55 Km east of Golpayegan City, Central Iran (below figure). The complex occurred in Sanandaj–Sirjan structural–metamorphic zone which is 1,500 Km in length and 150 to 200 Km in width. The Muteh complex which consists of nine gold deposits such as Chah Khaton and Senjedeh have been extracted since 1991. The rocks in the vicinity of the Muteh deposit are predominantly schist and gneiss, subsidiary amphibolite and quartzite, local marble, and magnetite horizons. Hydrothermal alteration associated with the gold occurrences is characterized by intense, pervasive bleaching of the host rocks. In areas where alteration is less intense, it can be seen that the bleaching occurs along small fractures crosscutting the sub-horizontal foliation of the host rocks. Alteration zones in the deposit consist of silicification and argilic types. There is silicic veins and veinlets by aperture between 1 cm and 1 m and rarely consist of pyrite, chalcopyrite, malachite, and Fe oxides (Rachidnejad-Omran et al., 2002; Moritz et al. 2006; Mohammadi et al. 2013; Kouhestani et al. 2014; ).

You can see the following references for this deposit:

- Rachidnejad-Omran N., Emami, M.H., Sabzehei, M., Rastad, E., Bellon, H. and Piqué, A., 2002. Lithostratigraphie et histoire paléozoïque à paléocènes des complexes métamorphiques de la région de Muteh, zone de Sanandaj-Sirjan (Iran méridional): *Comptes rendus Geoscience* 334, 1185–1191.
- Moritz, R., Ghazban, R., Singer, B.S., 2006. Eocene Gold Ore Formation at Muteh, Sanandaj-Sirjan Tectonic Zone, Western Iran: A Result of Late-Stage Extension and

Exhumation of Metamorphic Basement Rocks within the Zagros Orogen, Economic Geology, 101, pp

- Mohammadi, A., Khakzad, A., Rashidnejad Omran, N., Mahvi, M.R., Moarefvand, P., Afzal, P., 2013. Application of number-size (N-S) fractal model for separation of mineralized zones in Dareh-Ashki gold deposit, Muteh Complex, Central Iran. Arabian Journal of Geosciences 6: 4387-4398.
- Kouhestani, H., Rashidnejad-Omran, N., Rastad, E., Mohajjel, M., Goldfarb, R.J., Ghaderi, M., 2014. Orogenic gold mineralization at the Chah Bagh deposit, Muteh gold district, Iran. Journal of Asian Earth Sciences 91, 89-106.



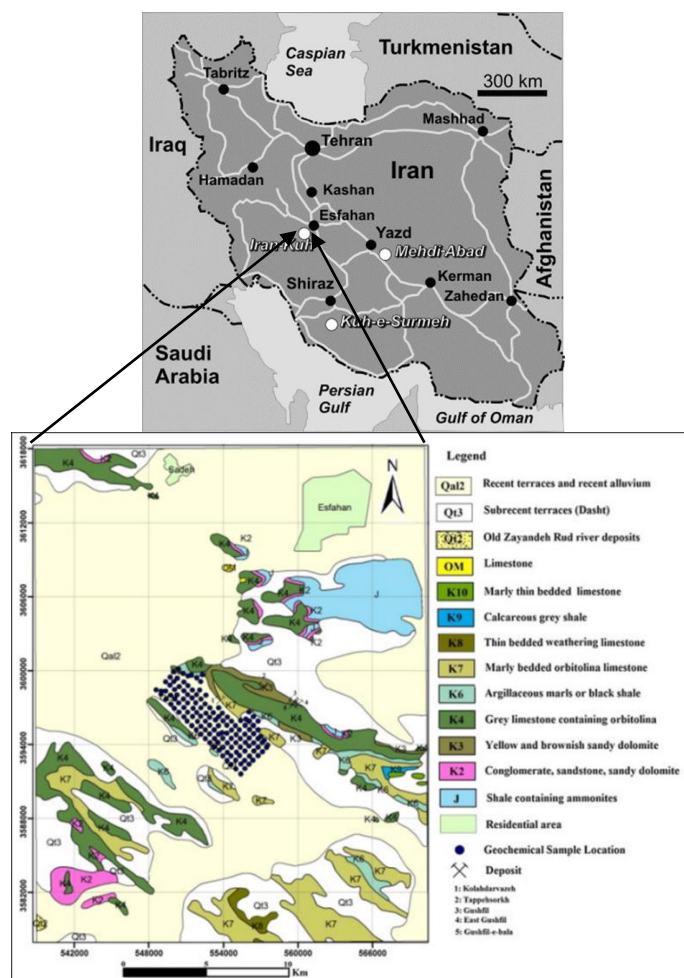
*Location of the Muteh Complex and the Iranian famous hydrothermal deposits of Agdarreh (gold), Zarshouran (gold), and Angouran (mixed sulfide-nonsulfide zinc) at the intersection of the Sanandaj-Sirjan metamorphic zone with Cenozoic-Quaternary magmatic belt of Urumieh-Dokhtar (Moritz et al. 2006).*



### 3. Irankuh Zn-Pb mines (led by D. Leach)

The Irankuh district includes several sulfide and non-sulfide Zn–Pb deposits located in Irankuh Mountains, 20 km south of Esfahan (Central Iran), and belongs to the Sanandaj-Sirjan zone from the Zagros orogenic belt. The Irankuh region comprises several Zn–Pb deposits especially Goushfil (mainly sulfide ore) and Kolahdarvazeh (predominantly non-sulfide ore). The whole area shows an intensive and extensive faulting.

The Irankuh deposits are identified as Mississippi Valley Type (MVT) based on their discordant nature, emplacement along the Irankuh Fault, progressive depletion in stable C isotope ratios of the host dolomites and isotopic characteristics of the ore-stage dolomites and barites. These deposits are stratabound and carbonate-hosted bodies with an ore mineral assemblage consisting of sphalerite, galena, pyrite, marcasite, dolomite, calcite, quartz, rarely barite, fluorite, celestine, gypsum, anhydrite and pyrrhotite (Hosseini-Dinani et al. 2015; Mokhtari, 2015; Hosseini-Dinani and Aftabi, 2016).



*Geological map of the Irankuh area within its location in the map of Iran (Mokhtari et al. 2015)*

You can see the following references for this deposit:

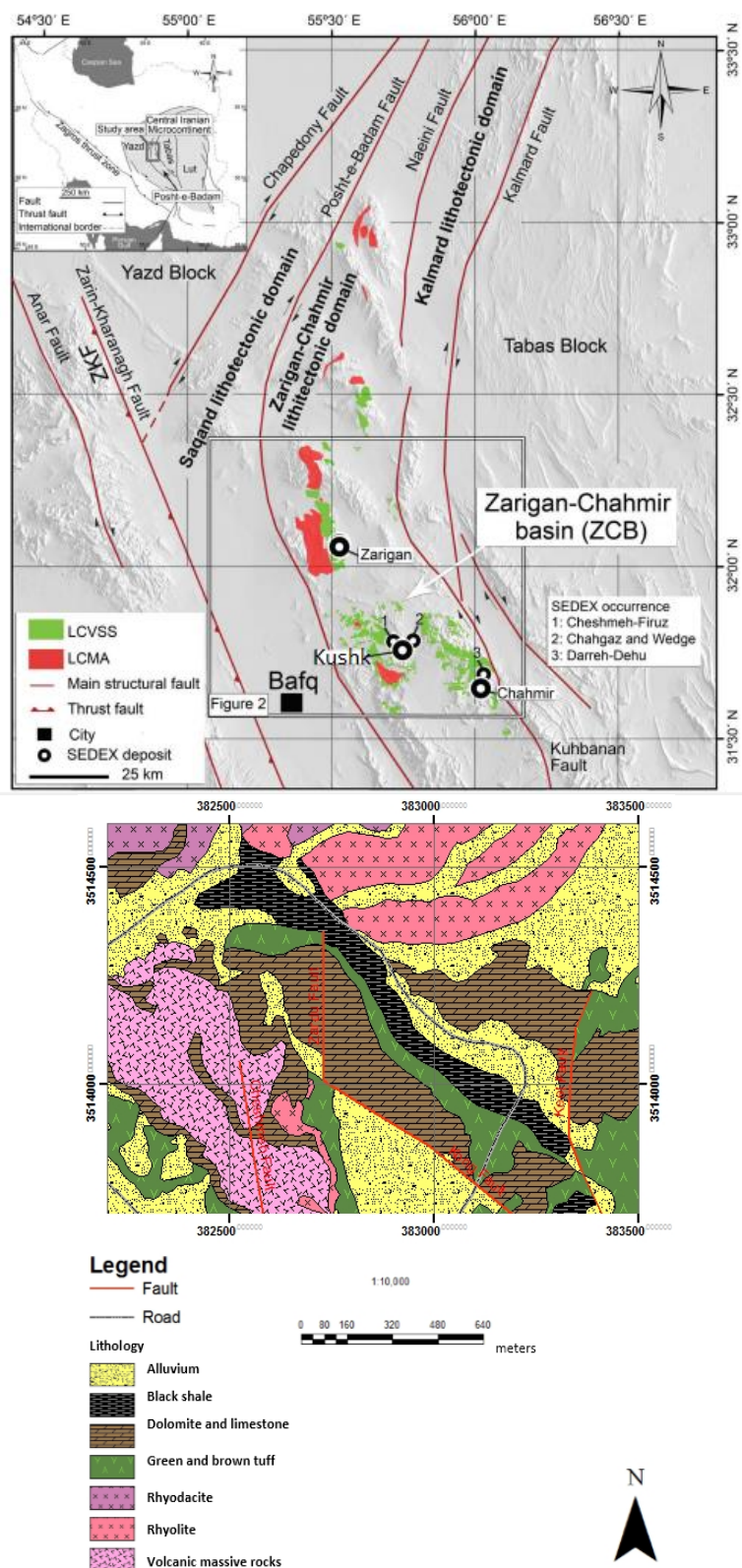
- Hosseini-Dinani, H., Aftabi, A., Esmaeili, A., Rabbani, M., 2015. Composite soil-geochemical halos delineating carbonate-hosted zinc–lead–barium mineralization in the Irankuh district, Isfahan, west-central Iran. *Journal of Geochemical Exploration* 156, 114-130.
- Mokhtari, A.R., Roshani Rodsari, P., Cohen, D.R., Emami, A., Dehghanzadeh Bafghi, A.A., Khodaian Ghegeni, Z., 2015. Metal speciation in agricultural soils adjacent to the Irankuh Pb–Zn mining area, central Iran. *Journal of African Earth Sciences* 101, 186-193.
- Hosseini-Dinani, H., Aftabi, A., 2016. Vertical litho-geochemical halos and zoning vectors at Goushfil Zn–Pb deposit, Irankuh district, southwestern Isfahan, Iran: Implications for concealed ore exploration and genetic models

#### 4. Kushk Zn-Pb mines (led by D. Huston)

The zinc–lead SEDEX stratiform deposits at Kushk, Chahmir, and Zarigan formed in the same tectono-sedimentary environment (Posht-e-Badam Block). The SEDEX type Kushk zinc–lead deposit is the biggest zinc–lead deposit of Bafq area. Related to a caldera structure, the area contains outcrop of various rock types including volcanic and sub-volcanic rocks (rhyolites, rhyodacites, dacites, and rhyolitic tuffs) and sedimentary rocks (shale, limestones, and dolomites). Mineralization at the deposit is hosted by Neoproterozoic black shales, and sedimentary breccias exist in the lower sandstone and silty limestone lithologies recorded in the northeastern part of the deposit. The paragenetic sequence of minerals indicates two stages of lead ore (galena) mineralization and one stage of zinc ore formation. Overall, the Kushk deposit is a fine-grained stratiform-banded deposit, with sphalerite, galena and pyrite the main sulfides developed. The ore-bearing sequence of footwall limestones and hanging-wall dolomites within black shales outcrops in the Zardu Syncline and is truncated by the northwest–southeast trending Kushk Fault (Samani, 1988; Rajabi et al. 2012; Heidari Dahooei et al. 2016).

You can see the following references for this deposit:

- Samani B.A., Metallogeny of the Precambrian in Iran. *Precambrian Research*. 1988, 39, 85-106.
- Rajabi A., Rastada E., Alfonso P., Canet C., 2012, Geology, ore facies, and sulphur isotopes of the Koushk vent-proximal sedimentary-exhalative deposit, Posht-e-Badam Block, Central Iran. *International Geology Review* 54, 1635–1648.
- Heidari Dahooei, A., Afzal, P., Lotfi, M., Jafarirad, A., 2016. Identification of mineralized zones in Zardu area of Kushk sedex deposit (Central Iran) based on geological and multifractal modelling. *Open Geosciences* 8: 1-11.



*The Zarigan-Chamir basin map within Zn–Pb SEDEX deposits and Geological map of Kushk deposit (Rajabi et al. 2012; Heidari Dahooei et al. 2016)*



## Registration Form:

### General Information:

Given name: \_\_\_\_\_ Surname: \_\_\_\_\_  
Date of birth: \_\_\_\_\_ Gender: \_\_\_\_\_ Title (Mr./Ms./Dr./Prof.): \_\_\_\_\_  
Country of residence: \_\_\_\_\_ City: \_\_\_\_\_ Passport no.: \_\_\_\_\_

### Education:

Graduated ☐ Student ☐ Major study: \_\_\_\_\_  
Bs ☐ Msc ☐ Ph.D ☐ University name: \_\_\_\_\_

### Applicant Position:

Job title: \_\_\_\_\_ Institute/Organization: \_\_\_\_\_  
Experience (years): \_\_\_\_\_  
Are you a member of geosciences/mining associations? Please list your memberships.

### Contacts:

Email: \_\_\_\_\_  
Address: \_\_\_\_\_ Tel: \_\_\_\_\_

I am applying for the following courses:

Orogenic Gold Deposits (R. Goldfarb)	Saturday	1 Oct.	<input type="checkbox"/>
Porphyry Deposits (J. Richards)	Sunday	2 Oct.	<input type="checkbox"/>
Epithermal Deposits (J. Richards)	Monday	3 Oct.	<input type="checkbox"/>
Mississippi Valley-Type (MVT) deposits (D. Leach)	Tuesday	4 Oct.	<input type="checkbox"/>
Volcanogenic Massive Sulfide (VMS) deposits (D. Huston)	Wednesday	5 Oct.	<input type="checkbox"/>
All theoretical courses	Saturday- Wednesday	1-5 Oct.	<input type="checkbox"/>

I am applying for the field trips:

Muteh Gold Complex (R. Goldfarb)	Thursday	6 Oct.	<input type="checkbox"/>
Kushk Zn-Pb Mine (D. Huston)	Thursday	6 Oct.	<input type="checkbox"/>
Irankuh Zn-Pb Mines (D. Leach)	Friday	7 Oct.	<input type="checkbox"/>
Kahang Porphyry Deposit (J. Richards)	Friday	7 Oct.	<input type="checkbox"/>

Please fill the registration form and send it to [info@samanehkansar.ir](mailto:info@samanehkansar.ir) or [info@samanehkansar.com](mailto:info@samanehkansar.com)  
If you have any questions please, do not hesitate to contact Ali Sholeh: [sholeh@samanehkansar.ir](mailto:sholeh@samanehkansar.ir)

Applicant name

Date

Applicant signature