Natural gas leaks in Boston

NATHAN G. PHILLIPS[1*], ROBERT ACKLEY[2], ERIC CROSSON[3], ADRIAN DOWN[4], JON KARR[4], AND ROBERT B. JACKSON[4]

[1]Boston University, Boston, USA, nathan@bu.edu (* presenting author)
[2]Gas Safety, Inc., Southborough, USA, bobackley@gassafetyusa.com
[3]Picarro, Inc, Santa Clara, USA, eric@picarro.com
[4]Duke University, Durham, USA, adrian.down@duke.edu, jkarr@duke.edu, jackson@duke.edu

Introduction and Methods

There are large uncertainties in the fate of lost and unaccounted gas from the natural gas process chain, including in distribution pipeline systems [1,2]. To assess the spatial pattern and typical leak rate of natural gas leaks in an urban distribution system, we drove and mapped leaks on the 785 centerline road miles in the City of Boston. We used a GPS-equipped cavity ringdown methane analyzer, sampling the air above road surfaces. Additionally, to assess leak rates, we deployed gas accumulation chamber on 25 representative gas leaks. Finally, we identified sources of methane leaks using carbon isotope analysis and human olfactory detection of the odorant mercaptan, which is added to pipeline gas.

Figure 1: Methane leaks from natural gas pipelines in the Beacon Hill neighborhood of Boston. Yellow bars represent methane concentrations in parts per million; the highest values recorded exceed 15 times background levels.

Results and Conclusions

We detected ca. 3,900 distinct elevated methane sources within the City of Boston. Isotopic and olfactory methods indicate that a majority of these methane sources are associated with the natural gas pipeline distrib ution system. Individual leak rates ranged from 28 cubic feet per day (CFD) to 315 CFD, averaging 110 CFD, more than half daily US household natural gas use. We conclude that the magnitude of gas lost by typical leaks and their frequency in urban areas like Boston have potential to amount to substantial total lost natural gas. The magnitude of lost and unaccounted gas [1] can represent several percent and more of typical total state greenhouse gas inventories, and total more than $1B nationally. Our discovery of widespread urban gas leaks provides impetus for concerted efforts to determine the total leak rate and corresponding greenhouse warming potential from natural gas distribution systems.

[1] Energy Information Administration, form EIA-176 (2010).
[2] Howarth *et al*. (2011) *Climatic Change* **106**, 679-690.

Isotopic constraints on the genesis of basanitic lavas beneath Haleakala

ERIN H. PHILLIPS WRITER[1*], KENNETH W.W. SIMS[1], VINCENT J.M. SALTERS[2]

[1]University of Wyoming, Department of Geology and Geophysics, Laramie, WY, USA, ephilli8@uwyo.edu (* presenting author), ksims7@uwyo.edu
[2]Florida State University, Department of Geological Sciences, Tallahassee, FL, USA, salters@magnet.fsu.edu

Although tholeiitic volcanism is predominant in Hawaii, the study of smaller volume, late-stage alkaline volcanism is imperative to understanding the magmatic history of the Hawaiian Islands and the dynamics of mantle plumes. Recent basanitic lavas from Haleakala represent an end-member in the compositional range of Hawaiian lavas and are hypothesized to tap magma from the fringe of the Hawaiian plume [1]. Indeed solid mantle upwelling rates inferred from U-series data from a limited number of samples from Haleakala [1] are consistent with both iso-viscous and thermo-viscous fluid mechanical models of plume upwelling [2,3].

However, these conclusions were based on a very small data set (5 samples) and additional isotopic data on alkaline lavas are essential for a more complete understanding of the genesis of late stage and rejuvenated stage volcanism. We present Hf, Nd, Sr, and Pb isotopic data, ^{238}U-^{230}Th and ^{235}U-^{231}Pa-^{227}Ac and major and trace-element data for a suite of 13 samples from Haleakala crater. These samples are relatively young, with ^{14}C ages ranging from 870 ± 40 to 4070 ± 50 years [4]. They are nepheline normative and LREE enriched, indicating that they represent small degree melts. Relative to main-stage tholeiites (Kilauea and Mauna Loa) and late-stage alkali basalts (Mauna Kea and Hualalai), the Haleakala crater samples come from a relatively depleted source (ε_{Nd} = 7.37-8.60; $^{87}Sr/^{86}Sr$ = 0.70314-0.70333; ε_{Hf} = 12.66-14.68). All samples have $^{230}Th/^{238}U$ >1 indicating that they originate from a source containing residual garnet. Consistent with earlier studies, the $^{230}Th/^{238}U$ (1.19-1.32) and $^{231}Pa/^{235}U$ (1.65-1.79) of these samples are much higher than other young Hawaiian lavas suggesting that basanitic lavas from Haleakala are the manifestation of a small degree of partial melting and relatively slow mantle upwelling rates.

[1] Sims et al. (1999) *Geochim. Cosmochim. Acta*, **63**, 4119-4138. [2] Hauri et al. (1994) *Jour. Geophys. Res.*, **99**, 24,275-24,300. [3] Watson and McKenzie (1991) *J. Pet.*, 32, 501-537 [4] Sherrod and McGeehin (1999) *USGS Open-File Report 99-143*, 14pp.